Registered at the G.P.O. for Transmission to Canada by Magazine Post.

Vol. 47. Ser. A. Part 6. pp. 197–236. JUNE, 1959.

THE REVIEW OF APPLIED ENTOMOLOGY

SERIES A: AGRICULTURAL

ISSUED BY THE COMMONWEALTH INSTITUTE OF ENTOMOLOGY.

LONDON:
COMMONWEALTH INSTITUTE OF ENTOMOLOGY,
56, QUEEN'S GATE, S.W.7.

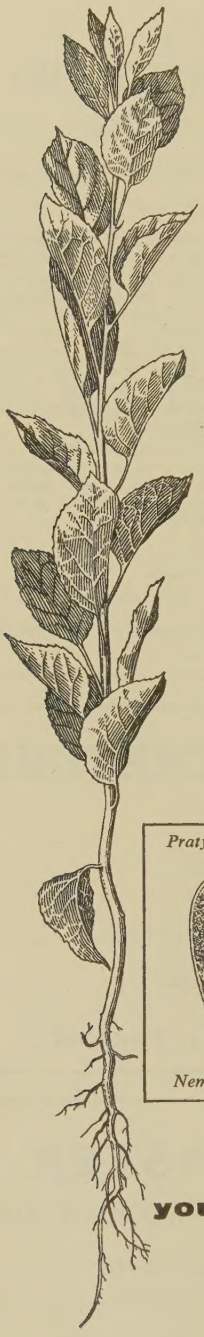
Price 6s. net.

Commonwealth Agricultural Bureaux

COMMONWEALTH INSTITUTE OF ENTOMOLOGY

Head Office—c/o British Museum (Natural History), Cromwell Road, London, S.W.7.

Publication Office and Library—56, Queen's Gate, London, S.W.7.



So grows a tree

Seed and shoot, sharpness of bud, first paired leaf. So grows a tree. On which one day a child may swing or lovers carve their names, a tree which can out-stature the man who sowed it, yet may be killed by something no greater than a speck of dust.

Individually, root-lesion nematodes (*Pratylenchus penetrans*) are almost invisible to the naked eye. But in their teeming swarms—many thousands may feed on the root system of a single seedling tree—they are capable of such destruction that an entire nursery may be made utterly useless and the land have to be abandoned. Even crop rotation is of no avail, for the nematodes return to the attack the moment the original crop is replanted, even after an interval of several years. The only hope is complete fumigation of the soil, and in the Netherlands, where agricultural land is restricted and every acre must be used to advantage, it has been found that there is one outstanding method of such soil-cleaning: with D-D Soil Fumigant, developed by Shell.

Injected in the autumn, the dark brown D-D liquid rapidly vaporizes into a powerful penetrating gas. The following spring, the nursery can be re-sown, with the knowledge that the young trees will live and grow unmolested by nematodes, and that the soil will remain sweet and clean. In one nursery in Holland, for example, excellent crops were raised in D-D treated soil *three years after application.*

Pratylenchus spp.

Nematode x 75

D-D

D-D is one of a series of Shell pesticides for world-wide use. Between them, aldrin, dieldrin, endrin, Phosdrin, D-D and Nemagon control virtually every significant world pest, both below and above the soil. If you have a pest problem, consult your Shell Company.
Whatever Shell does, Shell does well.

you can be sure of SHELL chemicals

Issued by the Shell International Chemical Company Limited and the Bataafse International Chemie Mij. N.V. For further information consult your Shell Company (in the U.K., apply to Shell Chemical Co. Ltd)

Martignoni (M. E.) & Zemp (H.). **Versuch zur Bekämpfung des Lärchenblasenfusses *Taeniothrips laricivorus* Kratochvíl und Farský (Thripidae, Thysanoptera) mit einem systemischen Insektizid.** [An Experiment on the Control of the Larch Thrips, *T. laricivorus*, with a Systemic Insecticide.]—*Mitt. schweiz. Anst. forstl. Versuchsw.* **32** fasc. 1 pp. 1–22, 2 pls., 7 figs., 16 refs. Zürich, 1956. (With Summaries in French, Italian & English.)

Vité (J. P.). **Über einige Versuche zur Bekämpfung des Lärchenblasenfusses durch Baumimpfung.** [Some Experiments on Control of the Larch Thrips by Tree Injection.]—*Schweiz. Z. Forstw.* **108** no. 2 pp. 81–92, 6 figs., 10 refs. Berne, 1957. (With a Summary in French.)

Taeniothrips laricivorus Krat. & Farský is the most important insect pest of larch in central Switzerland [*cf. R.A.E.*, A **44** 207] and in the first of these papers an account is given of an experiment carried out in 1955 on its control by means of Metasystox (dimethyl 2-(ethylthio)ethyl phosphorothioate [methyl-demeton]). A heavily infested plantation of trees 14 years old near Schaffhausen was selected, and the treatment was applied in early July, so that adults of the first generation and young nymphs of the second might be affected. Application was by means of a band of cellulose wadding tied round the scraped bark of the trunk and an outer sleeve of plastic tied at the bottom and, after application of the insecticide, at the top also. The insecticide was in the form of a 50 per cent. emulsion concentrate, which was diluted to contain 2·5 or 5 per cent. toxicant, and 250 ml. diluted emulsion was applied per tree. The crowns of the trees were examined with the help of ladders in early September, and it was found that the stronger emulsion gave very good results, the leading shoots remaining green right to the tip and the crowns showing greatly reduced damage. The weaker emulsion was less satisfactory but had considerable effect, whereas the leading shoots on untreated trees were badly damaged and reduced in growth. The effectiveness of the treatment was found not to vary with the height of the tree, but was reduced with increasing girth, which accounted for some variation in the results obtained. The method is considered practicable, especially in view of the fact that only selected trees destined to form part of the ultimate stand need be treated, but it requires further development.

The author of the second paper briefly describes the same experiment and two other methods by which systemic insecticides were introduced into the sap stream of larch trees for the control of *T. laricivorus*. These were by means of an aluminium cartridge case having blunt teeth cut round the open end, which is driven into the trunk and filled with insecticide through a hole at the other end, and by means of a hollow knife, which is driven nearly an inch into the trunk and has two openings in the cutting edge, through which the insecticide is introduced. Leakage is prevented in both cases by rubber rings. The cartridge case was useful for applying insecticide in very high concentrations, because of its small volume, but led to some local injury to the cambium. The knife reduced this damage and led to equally effective distribution of insecticide through the tree.

de Robertis (A.). **Contributi per la conoscenza delle malattie del mandorlo in Puglia. *Polydrosus* (*Conocetus*) *calabricus*, Faust (Col. Curculionidae). Prima segnalazione di un nuovo parassita.** [Contributions to Knowledge of Diseases of Almond in Apulia. First Occurrence of a new Pest, *Polydrusus calabricus*.]—*Frutticoltura* 1957 no. 1 pp. 85–88, 4 figs., refs. Bologna, 1957.

Stone-fruit trees, and especially almond, have for the last ten years been increasingly damaged in Apulia by the adults of *Polydrusus calabricus*

(Faust). These weevils appear in April and feed on the young shoots and leaves, which are almost entirely destroyed when the infestation is heavy. Pairing occurs in late June and July, and oviposition is over by the end of July. The eggs are laid on the leaves, but sometimes fall to the ground, and the larvae develop in the soil on plant roots. *P. calabricus* has not previously been recorded as a pest, and its recent increase is attributed to a decline in the numbers of birds, which are its only natural enemies. A spray of 0·5 per cent. lead arsenate applied in May gave complete control.

Lock (G. W.). **The Sisal Weevil.**—*Kenya Sisal Bd Bull.* no. 24, [4] pp., 4 figs., 3 refs. Nairobi, 1958.

The author briefly describes all stages of *Scyphophorus interstitialis* Gylh. (*acupunctatus* Gylh.), which injures sisal [*Agave sisalana*] in East Africa and elsewhere, records its spread in Tanganyika and Kenya, and gives notes on its bionomics and the damage caused, based partly on the literature [*cf. R.A.E.*, A **25** 47]. The egg, larval, prepupal and pupal stages of this weevil last 3–5, 21–58, 4–10 and 7–23 days, respectively, and complete development requires about 50–90 days, depending on conditions. The females lay 25–50 eggs each, in a moist environment, over about six months, at the rate of about two a week. The adults damage the leaves, and the larvae bore in the tender subterranean tissues, causing small plants to die. In tests in Tanganyika in 1957, the total percentage loss of plants was reduced from 66 to 1·8 by treating the planting holes, before planting, with about 7 g. dust prepared by diluting a 40 per cent. aldrin wettable powder with 25 times its weight of ground limestone or pouring about 100 cc. of a liquid prepared by diluting Dieldrex 15 [15 per cent. dieldrin concentrate] in 160 times its volume of water down the heart of the plant after planting. Both treatments establish a zone of treated soil round the plant, which kills or repels the ovipositing females as they approach.

Locust and other Insect Control in Technical Cooperation Programs in the Near East, South Asia, and Africa, 1951–57. A Report of the Regional Insect Control Project.—*Misc. Publ. U. S. Dep. Agric.* no. 770, ii + 147 pp., 62 figs., 10 maps. Washington, D.C., 1958.

The Regional Insect Control Project of the U.S. Department of Agriculture was developed as a result of a request to several countries for aid in combating a serious outbreak of *Schistocerca gregaria* (Forsk.) in Persia in 1951. Its scope was later expanded to include further countries in the near East, North Africa and South Asia and the control of insects other than locusts. Brief accounts of the work are given in this publication, arranged under the 12 countries concerned, together with a list of the insects and mites of agricultural or other importance that were encountered.

Stower (W. J.). **The Colour Patterns of Hoppers of the Desert Locust (*Schistocerca gregaria* Forskål).**—*Anti-Locust Bull.* no. 32, [4+] 75 [+10] pp., 6 col. pls., 23 figs., 17 tables (5 fldg.), 53 refs. London, 1959.

The following is virtually the author's summary of this account of work in Eritrea and Somaliland in 1949–54. A method for measuring the colour patterns of hoppers of *Schistocerca gregaria* (Forsk.) objectively by means of the Munsell Book of Color is described. When this method is used, the

results obtained in measuring colour patterns by different observers are comparable. The components of the colour patterns are numerous. The ground colour of the frons and of the post-ocular patch can apparently be measured more accurately than that of most other body regions. Furthermore, the range of colour variation in these two body regions is greater than in others, the ranges are more distinctly separable into classes and the ground colours are infrequently obliterated by the dark patterns. Consequently, the classification of the colour types has been based primarily on the coloration of these two regions, and the characteristics of the dark patterns have been used to achieve the final classification. Within the limits of the available data and the number of populations studied, it is concluded that inferences on population history can probably be derived from the characteristics of the ground colour of the frons and the post-ocular patch, and of the pronotal dark pattern. Therefore, the two former characters, as well as being more suitable for classification purposes, are also of value in the application of colour data to field studies on populations. Furthermore, although the colour patterns may be very complex, it may be sufficient to describe the colour types by reference to only three pattern characters. It has been found necessary to erect a large number of colour types. This is due to the very great complexity of colour variation amongst hoppers and to the possibility that only very slight differences of coloration may be indicative of different histories. The complex classification of colour types is partially justified by its usefulness in the characterisation of populations by their hopper colour-type composition and the establishment of particular "indicator" types peculiar to certain populations. The final justification of the classification must depend on whether the results obtained from the present study of a limited number of populations can be confirmed by its future application to large numbers of populations.

Although hopper populations can be described in respect of their colour-type composition, the maximum information on population history is not obtainable on this criterion alone, as populations of different histories may be very similar in the colour types present and their frequencies. The "indicator" colour types peculiar to certain population histories are comparatively rare; consequently, their value for determining population history is restricted if the samples are small. The range of colour variation amongst hoppers has been divided into a number of colour types that are intergrading, and the process of colour change between the extremes of the range is a continuous one. It appears that the rates of colour change of the frons and of the post-ocular patch may be different and that the ground colour of the latter region tends to be relatively nearer to the red extreme, or to the green extreme, of the range, than the ground colour of the frons, in congregating and dissociating hoppers, respectively. Hence the mean hue of the ground colour of the frons in a sample can provide an estimate of the deviation of that sample from the extremes of the recorded range, while the actual differences between the mean hues of the ground colours of the frons and the post-ocular patch and their relative deviations from the extremes of the ranges permit an assessment of the direction in which the colour change is taking place. From the latter, an inference as to whether congregation or dissociation is occurring within a population, or whether a population is *solitaria* or *gregaria*, may be made. This conclusion has been found to be reasonable for hoppers in the second–fifth instars in the populations studied, but in the first-instar hoppers, which tend to show very small, if any, differences between the two body regions, differentiation between *congregans* and *dissocians* populations may not be obtainable from the hue of the ground colour alone. In this instar, although *solitaria* and *gregaria* populations may be easily distinguishable, intermediate types of populations may have similar colour-type compositions, even though the histories have

been dissimilar; differentiation between *congregans* and *dissocians* populations in these cases may be possible by reference to the degree of the deviation of the mean hue of the frons ground colour of the samples from the extremes of the known range, in conjunction with observations on whether or not the hoppers were in groups or bands. The characteristics of the dark pattern of the pronotum can be used, particularly in the second and fifth instars, either to confirm inferences drawn from the relative mean hues of the frons and post-ocular patch or to identify *congregans* and *dissocians* populations when the phase may be in doubt from the ground colour measurements. In *congregans* hoppers, the dark patterns are well defined and pigmented rings occur at the bases of pronotal hairs, a condition not observed in *dissocians* hoppers, in which the shadow areas of the dark patterns indicate a previously greater extent of areas of dark pigments.

The principal stimulus that appears to influence hopper coloration is considered to be fluctuations of population density. However, other environmental factors can affect hopper coloration. In low-density populations, the pigmentation of green-extreme hoppers appears to show a relationship to the colour of the foliage of the plants in which the individuals are living; also, in such populations, in the fourth and fifth instars, the frequency of colour types other than the green extreme is possibly increased, either directly or indirectly, by the desiccation of the vegetation. Hoppers in bands living under very hot and exposed conditions show modifications of the *gregaria* coloration that simulate those arising in *dissocians* hoppers; it is possible that this is related directly to high temperatures, although the concomitant conditions of exposure to high radiation or heightened activity could be factors responsible for the observed colour changes. The magnitude of the colour changes of hoppers depends upon the stage at which the fluctuations of the social and physical environment occurred and their intensity. Therefore, the deviation from the extremes of the range of colour variation may be used to assess the point at which the external conditions changed. Morphometric differences between parent adults may not be evident from the colour types of the first-instar hoppers as the coloration of the latter appears related to the population-density history of the parent adults prior to oviposition. However, *congregans* populations, in which increase of population density occurred before the hopper stages and in which the hoppers were in bands throughout their lives, may be differentiated from *gregaria* populations by hopper coloration in the fifth instar.

CHAPMAN (R. F.). **Field Observations on the Behaviour of Hoppers of the Red Locust** (*Nomadacris septemfasciata* **Serville**).—*Anti-Locust Bull.* no. 33, [2+] 51 pp., 27 figs., 33 refs. London, 1959.

The following is substantially the author's summary of this account of investigations on the behaviour of hoppers of *Nomadacris septemfasciata* (Serv.) in the Rukwa Valley, Tanganyika, during 1954–56. Hoppers were present during the rainy season from January to March. More rain was recorded in the 1955–56 season than in the previous two, but relative humidities were consistently high at all times, with dew deposited at night. The diurnal range of temperatures during January was about 10°C. [18°F.], compared with 16°C. [28·8°F.] in August. Maximum temperatures were lowest in January, when the amount of sunshine was only about half that recorded in September (nine hours per day). In the rainy season the winds were rather variable.

The highest population studied was that of 1955, but no marked differences in head width [*cf. R.A.E.*, A **45** 411] were recorded. In 1956, hoppers in bands were nearer *gregaria* in coloration than were isolated individuals, but

this difference was not observed in 1954. The adults resulting from these hopper populations were phase *transiens* with a slight shift towards *solitaria* in 1956. Hopper development took 6–10 weeks, the earlier instars developing more rapidly than the later ones. The rate of development varied in different habitats, being higher in areas dominated by the grass *Echinochloa* than elsewhere. Hoppers roosted overnight in tall grass, ascending to the tops in the morning at first light. The movement was initiated by increasing light intensity and was upward because the hoppers were previously orientated with their heads in that direction. The evening ascent was related to a steep fall in temperature. At other times of day, ascent was induced by rising or falling temperature or by auditory stimulation. Climbing, resulting in the avoidance of excessively high temperatures near the ground, was also seen. Morning descent was produced by a sharp rise in temperature, the movement being directed by visual stimuli, possibly food. At other times, descents were caused by high winds and rain. Orientation to the sun varied under different conditions. Flanking was usual in the early morning and late evening, and the facing position during the heat of the day. The change-over from flanking to facing occurred at an air temperature of about 30°C. [86°F.]. Locusts moved round the grass stems in the course of the day as the sun moved across the sky. Under sunny conditions, hoppers frequently showed a preference for the lee sides of stems. Flanking locusts were hotter than facing or backing locusts, and those on the lee sides of stems were hotter than those exposed to the wind. Orientation was also partly to light.

The adults of *Nomadacris* scatter before oviposition [*cf.* **46** 302], so that the egg-pods that gave rise to the hoppers studied were widely distributed. The hoppers themselves tended to scatter on hatching. As the *Echinochloa* became taller, the hoppers concentrated in it, later tending to disperse again through lack of mutual visibility. Migration was seen between 25 and 32°C. [77 and 89·6°F.]; it was more active at the higher temperatures of this range, but inhibited above them. Hoppers progressed by leaping from stem to stem, maintaining a constant orientation. All the hoppers were similarly orientated. Orientation was not related to the lie of the grass, and the direction of band movement was also independent of this, being generally downwind and mainly northwards on warm days and southwards on cool days. Bands did not cover very great distances and probably spent only about 10 per cent. of the suitable time in migrating. Hoppers were more active in bands than when solitary. Feeding occurred mainly in the morning and evening. It was reduced at low temperatures, but only doubtfully so at high ones. No difference in feeding between the sexes was observed, but newly moulted hoppers contained less food. At first, feeding was restricted to *Cyperus* but later *Echinochloa* provided most of the evening feed. Activities were considered to be triggered-off by changes in stimulation, absolute levels of stimulating factors providing a background that merely limits the level of activity. The Rukwa habitat was considered to favour concentration but not aggregation, to which attention should be paid for an understanding of the origin of outbreaks.

JOHNSON (B.). **Factors affecting the locomotor and settling Responses of alate Aphids.**—*Anim. Behav.* **6** no. 1–2 pp. 9–26, 3 figs., 21 refs. London, 1958.

The following is virtually the author's summary. In environmental conditions suitable for flight, alate aphids typically fly from their parent food-plants, and they cannot normally be brought to settle down on those or other plants until after they have engaged in flight or other activity. In

unsuitable flight conditions, they remain on the plants but do not respond to them by feeding and reproducing. Aphids alighting on plants after flight normally spend some time wandering and probing, and they may settle down. By allowing young alatae of *Aphis fabae* Scop. short tethered and untethered flights of a minimum of 10–20 seconds and then putting them on a leaf surface, it was possible to induce wandering and probing behaviour. There is evidence that aphids do not normally alight and show this behaviour after being airborne for such a short time, and the behaviour of the aphids in the experiments was probably due to the composite effect of light and some part of the experimental procedure. Wandering and probing behaviour could also be produced by giving aphids a knockdown dose of carbon dioxide, and by allowing them an extensive period of activity other than flight.

The length of time aphids spent wandering on plants before they took off again, and whether or not they settled down to feed and reproduce, was influenced by the length of flight they had engaged in, the nature of the surface they were released on, and the physical environment. Aphids allowed to fly for five minutes or less and put on mature leaves in the light wandered and probed but soon took off again; aphids released on seedlings or on mature leaves that were then put in darkness, after short flights of a few seconds, and on mature leaves kept in the light after long flights of between 30 minutes and eight hours, frequently settled down to feed and reproduce. The effect of both short and long flights was soon lost and in the absence of strong contra-locomotory stimuli such as darkness or a very suitable food-plant, the aphids reverted to typical locomotory behaviour after showing some degree of the settling response (wandering and probing or settling down for some time).

Much of the behaviour of alate aphids can be grouped under two opposing general responses, namely the locomotor and the settling responses. It is suggested that the stimuli determining the type and strength of response of aphids at any time are principally of the same kinds as those shown in the experiments to affect the strength of the settling response.

CHAPMAN (R. F.). **A Field Study of the Potassium Concentration in the Blood of the Red Locust, *Nomadacris septemfasciata* (Serv.), in Relation to its Activity.**—*Anim. Behav.* **6** no. 1–2 pp. 60–67, 1 graph, 5 refs. London, 1958.

The following is almost entirely the author's summary. A field investigation was made of the potassium concentration in the blood of adults of *Nomadacris septemfasciata* (Serv.) in the Rukwa Valley, Tanganyika, in 1956. The concentration showed a regular increase during the heat of the day. It did not vary with the state of feeding but apparently depended on the blood volume. This was related to temperature, but whether directly or because of the effects of rough handling during catching at high temperatures was not determined. The concentration of sodium remained fairly constant throughout the day. Cage experiments confirmed that the blood volume was important in determining the concentration of potassium. No increase in blood potassium was observed after feeding, and this suggests an efficient regulating mechanism. High concentrations of potassium chloride fed to locusts were found to cause paralysis. Recovery after feeding on more dilute solutions was not complete even after seven hours. The experiments provided no support for the hypothesis that the displacement of locusts relative to vegetation areas was related to the potassium content of the grasses concerned [*cf. R.A.E.*, A **43** 298].

Proceedings of the Tenth International Congress of Entomology, Montreal, August 17–25, 1956. Section on Physiology and Toxicology.—*Proc. 10th int. Congr. Ent.* **2** pp. 3–393. Ottawa, 1958.

The following are abstracts of selected papers containing hitherto unpublished information of which the text is printed in full in this section [*cf. R.A.E.*, A **47** 176].

Smallman (B. N.). **The physiological Basis for the Mode of Action of Organophosphorus Insecticides,** pp. 5–12, 4 figs., 27 refs. The following is virtually the author's abstract. The physiological basis for the hypothesis that the organophosphorus compounds exert their insecticidal action by inhibition of cholinesterase is examined. The elemental basis for the hypothesis requires the demonstration of acetylcholine, acetylcholinesterase and choline acetylase in insects. Current evidence for these elements in insects is reviewed and its adequacy discussed. Recent findings on the acetylcholine content of insect nervous tissue (heads of house-flies [*Musca domestica* L.] and *Lucilia sericata* (Mg.)) are presented. Evidence that acetylcholine and the mechanisms for its metabolism occur in insects does not establish its functional significance or resolve the anomaly of the insensitivity of insects to exogenous acetylcholine. These problems are discussed in the light of recent evidence for the release of acetylcholine on stimulation of insect nerves, and the demonstration that the insect nervous system is impervious to applied acetylcholine. Finally, evidence is presented to show that acetylcholine accumulates in the nervous tissue of insects after inhibition of cholinesterase by organophosphorus compounds.

Metcalf (R. L.), Fukuto (T. R.) & March (R. B.). **Mechanisms of Action of Anticholinesterase Insecticides,** pp. 13–18, 14 refs. The following is based on the authors' abstract. The reactions between cholinesterase enzymes and phosphorus and carbamate insecticides are simple bimolecular reactions leading in the case of the former to phosphorylation of the enzymes and in the latter to the blocking of the active site by a relatively stable competitor. Thus, maximum activity in the phosphate compounds is a result of pronounced instability at the primary ester bond, while for the carbamates pronounced stability at the primary ester bond is essential. In addition to the stability of the molecule, its size, shape and charge are of importance in establishing its toxic action. The relation of these factors to insecticidal action was critically evaluated for a series of phenyl N-methyl carbamates, including the parent compound and compounds containing various substituents in the phenyl radicle. Good agreement was found between predicted values of toxicity, as deduced from the influence of substituent groups on the reactivity at the primary ester bond and on the degree of fit to the enzyme surface, and the experimentally determined LD50 values for the house-fly [*Musca domestica* L.] and greenhouse thrips [*Heliothrips haemorrhoidalis* (Bch.)] and inhibition of fly-head cholinesterase. Highly charged molecules, although excellent enzyme inhibitors, are of inferior activity as contact toxicants, apparently because of their inability to penetrate to the site of action. Similar approaches were made to the problems of explaining the toxic action of the phosphorothionate and phosphorodithioate compounds, such as parathion and malathion, which are highly stable and relatively inactive as cholinesterase inhibitors. These have been shown to be oxidised in plant and animal tissues to compounds of greater instability that are able to phosphorylate the cholinesterase enzymes and are consequently responsible for the ultimate toxic action.

Srivastava (A. S.) & Awasthi (G. P.). **Development of a new insecticidal Formulation for Mealy Bug Control. Synergism of Nicotine Sulphate with Sesame Oil,** pp. 243–244, 1 fig. *Drosicha stebbingi* (Green) (*mangiferae* (Green)), which infests mango in India, is little affected by DDT or other

synthetic insecticides. In laboratory tests, nicotine sulphate was also ineffective unless it was combined with sesame oil. A spray of 0·1 per cent. nicotine sulphate and 1·25 per cent. sesame oil emulsion, with 0·25 per cent. soft soap, 0·3 per cent. sodium carbonate and 0·03 per cent. ethanol as the dispersants, gave only 10 per cent. mortality in 72–96 hours, but increasing the concentration of nicotine sulphate to 0·15 per cent. resulted in complete kill in 1–2 days. Sesame oil alone at 4 per cent. had no effect. The spray also gave high mortality in the field, and was superior to other insecticides.

Srivastava (A. S.) & Awasthi (G. P.). **An Insecticide from the Extract of a Plant,** *Adhatoda vasica* **Nees, harmless to Man,** pp. 245–246. In experiments in India, an extract of the dried powdered leaves of *Adhatoda vasica*, a common plant known to possess insecticidal properties, was evaporated and the resinous extract, which comprised 6·9 per cent. of the dried plant material, redissolved in ethanol to form a 1 per cent. spray and applied at various rates to filter papers. Adults of *Tribolium castaneum* (Hbst.) were confined on these for 24 hours and then transferred to untreated paper with food and examined daily. The lowest amount of extract applied (0·5 cc. per 11 sq. in.) caused 50 per cent. mortality in two days and 75 per cent. in four days, and the highest (2 cc. per 11 sq. in.) gave 70 per cent. mortality in two days and complete kill in four. The extract is harmless to man.

Hamilton (A. G.). **Variations in the metabolic Rate in male Desert Locusts** (*Schistocerca gregaria* **Forsk.**), pp. 343–347, 2 figs., 24 refs. The following is virtually the author's abstract. It has been found that the length of adult life of females of *Schistocerca gregaria* (Forsk.) reproducing parthenogenetically is approximately three times that of females producing sexually [*cf.* **44** 460]. In an attempt to investigate their metabolic rates (measured as carbon-dioxide output), it was necessary to study the metabolic rate of male locusts in order to obtain a standard metabolic rate not affected by oviposition. In these experiments it was found that there is a very rapid increase in the metabolic rate during the first few days of adult life. Then, as sexual maturity is reached, there is a gradual slowing down in the metabolic rate to a figure that is little over half of the peak rate.

Prasad (D.). **On the Distribution, Bionomics and Control of the Mango Shoot Gall Psyllid,** *Apsylla cistellata* **Buckton.**—*Indian J. Ent.* **19** pt. 2 pp. 78–83, 1 fig., 10 refs. New Delhi, 1957.

Apsylla cistellata (Buckt.), the bionomics of which are described [*cf. R.A.E.*, A **43** 235], has caused heavy losses of mangos in recent years in Bihar, especially on the Chotanagpur plateau. An extensive survey in 1951–56 revealed widespread infestation by this Psyllid in the Hazaribagh and Ranchi districts of the plateau, at elevations of 1,500–2,000 ft., and sporadic occurrences in several districts on the plains. There is only one generation a year, oviposition taking place throughout March. The eggs are laid along the mid-ribs of leaves of the February flush, and the females lay an average of 141 eggs each. Hatching coincides with the August flush, and the nymphs disperse over the tree, galls becoming visible by mid-September. The adults emerge in February and leave the galls in March. It is not certain whether the initiation of gall-formation is due to the nymphs, since none was found in several young galls examined.

Grafted trees are attacked more often than trees grown from seed, and there are varietal differences in susceptibility to infestation. In spray trials conducted in the Ranchi district in 1953–56, a mixture of 0·04 per cent. parathion with 0·25 per cent. DDT, applied three times at fortnightly

intervals during the emergence period, from the last week of February, reduced the percentage of infested twigs per tree to 4·4, as compared with 61·6 on untreated trees. Endrin at 0·04 per cent. reduced it to 8 per cent., but 0·25 per cent. dieldrin, aldrin, or BHC, and parathion or DDT alone, were of little value; sprays applied while the nymphs were within the galls or at the time of hatching were also ineffective. In 1953–55, mechanical removal of the galls resulted in heavier flowering and reduced infestation in the following season from 41 to 23 per cent.

Singh (Sardar) & Sharma (P. L.). **Destruction of Nests of Mound-forming Termites.**—*Indian J. Ent.* **19** pt. 2 pp. 91–95, 5 refs. New Delhi, 1957.

Measures advocated against mound-building termites in India are briefly reviewed, and an account is given of trials in 1955–56 in which chlorinated insecticides were tested for the control of *Odontotermes gurdaspurensis* Hlmgr. & Hlmgr., a common species in rural and urban areas in the Punjab. DDT and BHC were used as suspensions of 50 per cent. wettable powders, and aldrin as a diluted emulsion concentrate. Applications were made by breaking open a freshly-built pyramid on a mound and pouring the liquid into the cavity thus made. Pyramids in use were identified by their covered apertures; in deserted pyramids, the apertures are open. Observations of termite activity were made 1, 2 and 3 days after treatment, and further inspections were made for two months to ascertain the final results. In all, 16 mounds were treated with DDT, 36 with BHC and 45 with aldrin.

DDT suspensions at concentrations of 0·1–0·4 per cent., applied at rates of 6–24 gal. according to the volume of the mound (which varied from 42 to 252 cu. ft.), gave inconsistent results. Termites deserted the treated pyramid, but continued to live normally in the remainder of the nest. Applications were then made through four cavities, one on each side of the mound, and 24 gal. 0·1 per cent. DDT destroyed all termites in an average-sized nest about 3 ft. high and 17 ft. in circumference. A single application of 12 gal. 0·1 per cent. BHC was equally effective. Aldrin gave consistently good results at all the concentrations used, treatment with 12 gal. liquid per nest effecting complete control in three days, even at 0·0041 per cent. Treatment with 0·4 oz. of the aldrin concentrate in 12 gal. water is recommended.

Pradhan (S.), Jotwani (M. G.) & Rai (B. K.). **Bioassay of Insecticides. VII. Relative Toxicity of some organic Insecticides to the Larvae of *Euproctis lunata* Walker (Lymantriidae-Lepidoptera).**—*Indian J. Ent.* **19** pt. 2 pp. 96–100, 6 refs. New Delhi, 1957.

In this seventh part of a series [*cf. R.A.E.*, A **46** 470, etc.], statistical results are given of laboratory tests on the toxicities of some organic insecticides in direct sprays and films to larvae of *Euproctis lunata* Wlk. Technical grades of insecticide were used, except that p,p′DDT was recrystallised from the technical material. All the insecticides were dissolved in benzene and emulsified with Triton X-100. In the first series, field-collected larvae of uniform length were sprayed in petri dishes and transferred to clean containers, and mortality counts were made 72 hours later. Comparison of the LC50's showed that lindane [almost pure γ BHC], aldrin, dieldrin, diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate], isodrin and endrin were, respectively, about 1·3, 1·4, 5·9, 8·9, 19·7 and 31 times as toxic as p,p′DDT, whereas toxaphene, malathion and chlordane were less effective than DDT. In tests of films of some of

the insecticides, second- and third-instar larvae were exposed for four hours to dried spray deposits in petri dishes, and counts were taken after 48 hours. Dieldrin, diazinon and endrin were about 1·8, 8·2 and 11 times as toxic as p,p′DDT, and in this series γ BHC, as well as malathion, was inferior to DDT.

Rangarao (P. V.), Narasimharao (P. L.) & Tirumala Rao (V.). **Association of pinkish brown Blotch of Citrus Fruits with an Eriophyid Mite (*Phyllocoptes oleivorus* Ashmead).**—*Indian J. Ent.* **19** pt. 2 pp. 146–147, 1 ref. New Delhi, 1957.

Pinkish brown blotches occur, chiefly in late summer, on the rind of developing sweet oranges in Andhra State. They do not affect the shape or palatability of the fruits, but reduce their market value. In investigations on the cause, the blotches were found to be associated with infestation of the fruits by *Phyllocoptruta* (*Phyllocoptes*) *oleivora* (Ashm.), although sometimes only moulted skins of this mite were present. When 30 fruits showing initial infestation were selected and 15 of them freed from mites, none of these developed blotching. Of the others, 53 per cent. developed blotches, while the remainder, on which the mites subsequently declined in numbers, did not. Similar results were obtained in the following year.

Basu (A. C.) & Banerjee (S. N.). **Study on the Assessment of Damage done by *Hispa armigera* Ol. to Paddy Crop.**—*Indian J. agric. Sci.* **27** (1957) pt. 3 pp. 295–301, 1 fig., 16 refs. New Delhi, 1958.

An account is given of investigations carried out in West Bengal in 1949–54 to estimate the amount of leaf damage caused to the winter crop of rice by *Hispa armigera* Ol. It is concluded from the results that the percentages of leaf area destroyed are 2·14 in seedlings, 4·06 in the young transplanted crop, 0·54 at the flowering stage, and 0·02 at the grain stage, giving a total of 6·76 per cent. from sowing to harvest.

Gay (F. J.). **Termite Attack on Radiata Pine Timber.**—*Aust. For.* **21** no. 2 pp. 86–91, 1 ref. Canberra, 1957.

In view of the extensive plantations of *Pinus radiata* established in Australia and the increasing amount of this timber coming into use there, the susceptibility of both the tree and the timber to termite attack was investigated. In eastern Australia, the termites normally present in hardwood forests include *Coptotermes frenchi* Hill, which feeds on living trees, and *C. lacteus* (Frogg.) and *Nasutitermes exitiosus* (Hill), which feed on dead timber. When the plantations of *P. radiata* were established, *C. frenchi* was reduced or virtually eliminated by the felling and burning operations that preceded planting, and *N. exitiosus* died out as the amount of shade increased. The only healthy trees attacked were those at the margins of the plantations, where infestation by termites entering from neighbouring hardwood forest areas occurred. Observations on structural timbers in various parts of Australia over a period of more than 20 years had indicated that *N. exitiosus* damaged wood of *P. radiata* only slightly or not at all, but that it was often severely damaged or destroyed by species of *Coptotermes*, *Heterotermes* and *Schedorhinotermes*; furthermore, when closely associated with very susceptible hardwoods, it was often preferred to them. These findings were confirmed in field tests with *N. exitiosus* and *Coptotermes* spp., in which attack by *C. lacteus*, *C. frenchi* and *C. acinaciformis* (Frogg.)

was consistently heavy over a period of several years. In laboratory tests in 1951, samples of wood from trees at least 15 years old grown in Queensland and New South Wales were exposed for 84 days to attack by *N. exitiosus* and *C. lacteus* by means of standard laboratory colonies [*cf. R.A.E.*, A **45** 450]. The wood was not readily attacked by *N. exitiosus*, although no alternative food was provided, and the mortality rate among termites of this species that fed on it did not differ significantly from that among colonies kept without food. Two-thirds of the colonies of *C. lacteus* tested destroyed the samples within 84 days. Since the amount of wood consumed by this termite and the survival rate of the colonies differed little from those for *Eucalyptus regnans*, the standard susceptible hardwood, *P. radiata* must be considered equally susceptible.

Brimblecombe (A. R.). **Damage by Ants to plastic sheathed Cables.**—*Qd J. agric. Sci.* **15** no. 3 pp. 157–159, 1 fig. Brisbane, 1958.

In the autumn of 1956, the electric current in some of a considerable number of recently installed, small, polythene-sheathed underground telephone cables failed in Brisbane and Toowoomba, in Queensland, and the sheaths were found on examination to be pitted to varying depths and perforated, permitting the entry of moisture. Large populations of the ant, *Pheidole megacephala* (F.), were closely associated with the cables where the faults had occurred. In experiments at four sites, cables carrying continuous or intermittent current or none at all were buried about 6 in. apart at depths of 6–12 in. in the affected districts, and areas 8 ft. long and 6–12 in. wide on each side of them were sprayed with 2 per cent. chlordane in emulsion form. This gave protection for only 6–10 months at three sites at Brisbane, when unprotected cables were soon attacked, and an inconclusive result was obtained at Toowoomba.

Brimblecombe (A. R.). **Control of the Cedar Looper.**—*Qd J. agric. Sci.* **15** no. 3 pp. 159–160, 1 fig. Brisbane, 1958.

During trials of sprays against *Hypsipyla robusta* (Moore) in newly established plantations of *Cedrela toona* var. *australis* in Queensland in 1955, larvae of a Geometrid, *Pingasa* sp., attacked the young trees and severely defoliated some of them. The sprays were applied between 1st March and 16th May, usually at fortnightly intervals, and the results were assessed in late May, when the average height of the trees was 18 in. Outstanding protection against *Pingasa* was given by 0·025–0·1 per cent. endrin or 0·1–0·2 per cent. DDT in emulsion sprays and by 0·2 per cent. DDT in a wettable-powder spray, and significant control by a 0·05 per cent. dieldrin emulsion applied fortnightly, but not by lead arsenate alone or with white oil, and also by the 0·2 per cent. DDT emulsion spray alone or with 0·8 per cent. white oil, applied monthly.

Hoy (J. M.). **The Collection of *Hylemyia seneciella* (Meade) (Diptera, Muscidae) for Shipment to Australia.**—*N.Z. J. Sci.* **1** no. 3 pp. 417–422, 2 figs., 3 refs. Wellington, N.Z., 1958.

In 1957, following the establishment of *Hylemyia senecciella* (Meade) on ragwort (*Senecio jacobaea*) in the North Island of New Zealand [*cf. R.A.E.*, A **45** 172], a request was received from Australia for a shipment of material for use there in a campaign against the weed, and an account is given of the methods by which this was obtained. In January 1958, infestation of the small

quantity of *Senecio* remaining at the original liberation area in New Zealand was very low, possibly in part owing to the retarded flowering that followed a change from cattle to sheep in the animals grazing the land, but a moderately infested stand from which collections were made was found two miles away. Only the youngest capitula were infested, apparently because the appearance of the females and of the main crop of flowers had not synchronised, and the general level of infestation was lower than previously reported [**45** 173], possibly owing to weather conditions unfavourable for floral initiation. Inflorescences collected on 22nd January were inclined at an angle of 45° against trays containing sand, into which the full-fed larvae dropped for pupation. The flower stalks were placed in water, but after a few days a heavy infestation of mould developed on the inflorescences. These were thereupon removed, tied in loose bundles, and placed head downwards on ½-in. wire netting over the sand trays. The mould did not spread, and none developed on other inflorescences collected on 28th January and treated in the same way; fewer larvae were obtained from the second collection than from the first, since many had already left the inflorescences. By 10th February, most of the larvae had pupated, and the pupae were recovered by successive screenings eight days later and kept in fine sand until required. All but one of 33 dead larvae removed from eight of the 16 trays employed were parasitised, probably secondarily, by a nematode of the genus *Rhabditis*, which also parasitised two pupae. The remaining larva and 14 pupae were attacked by a fungus, and three pupae were damaged mechanically. For shipment, batches of 200 pupae were spread on pads of cotton-wool. These were then rolled up and inserted into glass tubes with cotton-wool at each end, and the tubes were packed between layers of cotton-wool in a wooden box. About 4,000 were dispatched in this way by air to Canberra on 26th February and arrived within 48 hours.

Cohic (F.). **Le " scolyte du grain de café " en Nouvelle-Calédonie.**—*Café, Cacao, Thé* **2** no. 1 pp. 10–14, 1 map, 1 ref. Paris, 1958.

Stephanoderes hampei (Ferr.) was observed on coffee in the north of New Caledonia in August 1948 and had spread almost throughout the island by 1953, in spite of attempts at limitation. Its rapid advance was favoured by the mixture of *Coffea arabica* and *C. robusta* grown on most estates, which made a succession of cherries available almost throughout the year, and by the frequency of abandoned plantations. The only alternative foodplant present is loquat (*Eriobotrya japonica*), the fruits of which are attacked in the same way as the coffee cherries, but it is not certain that development can be completed in them. Development of the Scolytid requires about 25 days, so that there are many generations a year.

It is recommended that only the most suitable species of coffee be grown in each plantation, in general *C. arabica* on the west coast and *C. robusta* on the east, and that a period of three months in the year free from coffee fruits be assured by the collection and disinfestation of all coffee cherries, ripe or unripe, fallen or on the trees, after harvest [*cf. R.A.E.*, A **10** 506]. Harvested cherries should be disinfested by water treatment or dusting with 10 per cent. DDT, storehouses should be sprayed with 0·5 per cent. dieldrin and the sacks dusted with 5 per cent. DDT or a pyrethrum powder.

In field tests of control by means of insecticides, the trees were sprayed with 0·5 per cent. BHC, 0·25 per cent. S.P.C. (polychlorocyclohexane sulphide) or 0·025 per cent. parathion, with a wetter, or dusted with 3 per cent. BHC. Two applications were made, at an interval of about three weeks. The percentage infestation before treatment was variable, ranging from 4·3 to 35·6. The four treatments gave similar results, the infestation

percentages at harvest (which was too early for accurate calculations on the dusted trees) being 8·5, 8, 12–15 and 0·5, respectively, as compared with 25, 34, 43–65 and 12 for no treatment. Some mortality of the insects in the cherries is afforded by a fungus thought to belong to the genus *Beauveria*. This gives 30–70 per cent. kill in the wet season, but is much less effective in the dry one. It attacks only living insects, and its absence from the treated cherries witnessed to the efficacity of the insecticides. It is recommended that treatment be applied as soon as 4–5 per cent. of the immature cherries are attacked, and repeated 15–20 days later, with a third application if necessary or if the second is washed off by rain. Dusting the soil with BHC after harvest is an additional precaution.

Barthel (W. F.), Green (N.), Keiser (I.) & Steiner (L. F.). **Anisylacetone, synthetic Attractant for Male Melon Fly.**—*Science* **126** no. 3275 p. 654, 7 refs. Lancaster, Pa., 1957.

Investigations in Hawaii showed that certain aromatic ketones attract males of *Dacus cucurbitae* Coq. Benzylacetone and anisylacetone were the most attractive, but anisylacetone proved superior in field tests. Analogous compounds were less effective. Anisylacetone can be regarded as 4-(p-methoxyphenyl)-2-butanone, and the introduction of another methoxy group on the benzene ring led to a compound that was no longer attractive to *D. cucurbitae* but was fairly attractive to *D. dorsalis* Hend., for which the rather similar methyl eugenol is the outstanding attractant [*cf. R.A.E.*, A **40** 230]. Anisylacetone was used in an extensive trapping programme in California almost immediately. A single male of *D. cucurbitae*, regarded as an isolated specimen of unknown origin, was taken.

Staub (A.). **Eine Methode zur Zucht der Bohnenblattlaus, *Aphis fabae* F. unter Laboratoriumsbedingungen.** [A Method of Rearing *A. fabae* under Laboratory Conditions.]—*Mitt. schweiz. ent. Ges.* **30** pt. 4 pp. 313–316, 2 figs. Berne, 1957.

The rearing method described was developed to provide large numbers of *Aphis fabae* Scop. at any time of the year as laboratory food for predators. Seeds of broad bean (*Vicia faba*) were soaked in water and germinated on damp vermiculite, and 2–3 were then placed over the opening of a small narrow-necked medicine bottle, containing water, and held in place by wadding. The shoots were infested with 150–250 aphids, this heavy infestation preventing too rapid plant growth, and the whole was covered with a plastic bag. Illumination was provided by neon tubes for 12 hours a day, and laboratory conditions of 18–25°C. [64·4–77°F.] and 40–60 per cent. relative humidity proved suitable. The aphid colonies developed rapidly and reached their maximum in about a fortnight, after which the plants collapsed.

Klingler (J.). **Über die Bedeutung des Kohlendioxyds für die Orientierung der Larven von *Otiorrhynchus sulcatus* F., *Melolontha* und *Agriotes* (Col.) im Boden. (Vorläufige Mitteilung.)** [On the Significance of Carbon Dioxide in the Orientation of Larvae of *O. sulcatus*, *Melolontha* and *Agriotes* in the Soil. (Preliminary Communication.)]—*Mitt. schweiz. ent. Ges.* **30** pt. 4 pp. 317–322, 7 figs., 9 refs. Berne, 1957.

Laboratory experiments are described showing that larvae of *Otiorhynchus sulcatus* (F.), *Melolontha melolontha* (L.) (*vulgaris* F.) and *Agriotes* sp. in

soil are attracted over distances of several inches to the plant roots on which they feed. A similar movement in the soil was caused by a weak source of carbon dioxide, so that production of the latter may be responsible for the reaction to plant roots of these and other soil organisms.

European and Mediterranean Plant Protection Organisation. **Colorado Beetle in Europe in 1957.** [*In English & French.*]—[3+] 21 [+1+] xviii [+1] pp., multigraph. Paris, 1958.

The occurrence and distribution of *Leptinotarsa decemlineata* (Say) on potato in Europe in 1957 [*cf. R.A.E.*, A **45** 331] are surveyed for the several broad geographical areas that appear to reflect present trends in infestation. The position was stable in the southern group of countries (Spain and Portugal), there was a slight regression in the western group (France, Holland, Belgium, Luxembourg, Germany and Switzerland), and no larvae were found in Denmark, though adults and eggs were present in one locality close to the German border. There was considerable spread, however, in central and eastern countries. It was only local in Italy, but the infested area increased in Czechoslovakia, Austria and Yugoslavia, and the numbers of pockets of infestation rose in Poland [*cf.* **46** 326]. The beetle was observed in the Soviet Union for the first time in 1949, in districts near the Polish frontier, but there was no increase until 1956, when heavy migrations from Poland resulted in 234 pockets of infestation in the Kaliningrad district and small increases in Lithuania and White Russia. Only 30 pockets were found in 1957, 20 in the Kaliningrad district, 6 in the Transcarpathian and Volin regions of the Ukraine, and four in the Brest and Grodno regions of White Russia. This reduction resulted from the institution of strict quarantine measures along the western frontier, combined with chemical control in and near infested areas. The control measures in use in the various countries are summarised.

Benassy (C.) & Bianchi (H.). **Incidence des traitements insecticides sur les parasites de coccides. Action des traitements "d'hiver" contre *Pseudaulacaspis pentagona* Targ., sur son parasite spécifique: *Prospaltella berlesei* How.**—*Phytiat.-Phytopharm.* **6** no. 3 pp. 135–141, 26 refs. Paris, 1957.

Attempts are being made in France to establish *Prospaltella perniciosi* Tower as a parasite of *Quadraspidiotus perniciosus* (Comst.), but it is not known how this Aphelinid will be affected by the insecticides applied against the Coccid. *P. berlesei* (How.) became established against *Pseudaulacaspis pentagona* (Targ.) many years ago [*cf. R.A.E.*, A **34** 362] and gave satisfactory control until recently, but outbreaks of *P. pentagona* have recently occurred in some areas, on mulberry and especially on peach [*cf.* **45** 116], and the use of insecticides is thought to have been partly responsible.

Tests were therefore carried out in 1955 to ascertain the effects of various sprays applied during the dormant period on *P. pentagona* and its parasite. Three mulberry trees were selected on which both host and parasite were present, the former as hibernating females and the latter as larvae and pupae in their hosts, and individual branches were sprayed on 10th March at an average temperature of 5°C. [41°F.] in sunny weather. Mortality was determined by Abbott's formula [*cf.* **13** 331]. A spray of summer oil emulsion caused little mortality of either host or parasite, killing only about 35 per cent. of either at the highest concentration used (nearly 2·5 per cent. actual oil). Similar sprays of oil emulsion with the addition of DDT or parathion were no more effective than oil emulsion alone against the Coccid,

but caused appreciable parasite mortality, this reaching 46·9 per cent. for 1·66 per cent. oil with 0·001 per cent. DDT and 51 per cent. for 2·4 per cent. oil with 0·045 per cent. parathion. A spray of DNC in an oil emulsion of the mayonnaise type gave high mortality of both, killing 97·4 per cent. of the Coccids and 64·5 per cent. of the parasites at a concentration affording 2·84 per cent. oil and 0·1 per cent. DNC, and a similar spray prepared from a concentrate of the soluble type killed 88·6 per cent. of the Coccids and 75·6 per cent. of the parasites at a concentration of 2·7 per cent. oil with 0·15 per cent. DNC. For all these sprays, parasite mortality rose rapidly with concentration.

The differences in host and parasite mortality are largely due to differences in susceptibility to the insecticides and their modes of action. Oil emulsion acts by asphyxia, and mortality of the two insects is thus about equal. The addition of parathion or DDT to it does not affect Coccid mortality, but the parasites are susceptible to them. The DNC sprays affect the Coccids more than the parasites, because the hardening of the host cuticle that results from parasitism hinders penetration and thus protects the parasites within; mortality of the latter was found in laboratory tests to occur mainly at the time of adult emergence. The mortality of the parasites varies with their stage of development, mortality of larvae being always higher than that of pupae, but this is again attributable largely to the effect of the progressive hardening of the host cuticle. A similar protective effect has been recorded in the Soviet Union for a parasite that mummifies its Coccid host [**43** 449]. These results illustrate the difficulties of applying sprays without causing high parasite mortality and the importance of determining the most appropriate time of application. Against *P. pentagona*, concentrated sprays of DNC in oil emulsion are probably the most promising.

Bouron (H.), Mimaud (J.) & Ronzel (G.). **Essais de produits pesticides sur** *Metatetranychus ulmi* **en 1956.**—*Phytiat.-Phytopharm.* **6** no. 3 pp. 143–150, 1 graph. Paris, 1957.

The experiments described were carried out on pear near Paris in 1956. In that year, hatching of the winter eggs of *Panonychus* (*Metatetranychus*) *ulmi* (Koch) began on 27th April, and young stages were abundant in early May. Deutonymphs were present on 7th May and adults on 9th. Summer eggs were laid from mid-May onwards, and the population increased until it was checked by cool wet weather in the first fortnight of June.

In tests against the mobile stages, the trees were sprayed on 10th May, after the appearance of the first adults, and again, in most cases on 4th June, when the hatching of the first-generation eggs was at its peak. Counts on 17th May showed that the best immediate results were given by methyl-demeton [dimethyl 2-(ethylthio)ethyl phosphorothioate] and parathion, whereas chlorobenzilate [ethyl 4,4′-dichlorobenzilate], Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] and a material referred to as chlorophenyl trichloroethanol [? 1,1-di(p-chlorophenyl)-2,2,2-trichloroethanol] were ineffective. By 29th May, these last three materials also gave good reductions in population, but methyl-demeton and parathion still showed the best results. Methyl-demeton, because of its effectiveness, and Aramite, because of plant scorching, were not applied a second time. On 14th and 29th June, methyl-demeton and parathion were still very effective, and the other materials, with the exception of Aramite, almost as good, the numbers of mites on 120 leaves on the last date being 101 and 338 for methyl-demeton and parathion, 343 and 466 for the trichloroethanol and chlorobenzilate, and 2,167 for Aramite, as compared with 6,795 for no treatment.

Two ovicides were tested in sprays against summer eggs on 23rd May and 14th June. Both were very effective, the numbers of mobile mites and (in brackets) eggs per 100 leaves on 29th June being 93 (45) for p-chlorophenyl p-chlorobenzenesulphonate and 112 (479) for 2,4,5,4′-tetrachlorodiphenyl sulphone (referred to as trichlorophenyl p-chlorophenyl sulphone), as compared with 1,587 (4,266) for no treatment. The difference between them was significant.

Cessac (M.) & Guillot (M.). **Efficacité sur le taupin de l'heptachlore utilisé en traitement des semences.**—*Phytiat.-Phytopharm.* **6** no. 3 pp. 151–156, 10 refs. Paris, 1957.

Heptachlor was compared with other insecticides for the treatment of seeds against wireworms in France in 1956. In a preliminary laboratory test, pots of soil about 6 in. in diameter were each infested with ten last-instar larvae of *Agriotes lineatus* (L.), and ten grains of wheat coated with lindane [almost pure γ BHC] or technical heptachlor at 0·02, 0·04 or 0·06 per cent. by weight or left untreated were sown in them. Both insecticides at the two higher rates gave complete protection against the larvae, whereas at the lowest one they permitted 3 and 5 per cent. loss of plants, respectively; there was 53 per cent. loss for untreated seeds. Larval mortality for the completely effective treatments was 20 per cent. after two months, as compared with 4 per cent. in the controls.

A field experiment was carried out in soil with a population of up to about 810,000 wireworms per acre, apparently almost all *A. lineatus*. The seed coatings were powders containing 10 per cent. parathion, 25 per cent. malathion, or 30 per cent. γ BHC or technical heptachlor, and they were applied to maize seeds at 0·02 per cent. by weight. Parathion and malathion were tested at such low rates in order to ascertain their threshold of effectiveness. The seeds were sown in rows on 9th May, plant counts were made between 25th May and 17th July, and the yield was estimated on 13th–14th November. At the first count, out of a possible 140 plants, there were averages of 122·6 for heptachlor, 112·1 for parathion, 107·7 for γ BHC, 84·9 for malathion and 96 for no treatment. Heptachlor maintained its superiority throughout, the numbers of plants at the last count averaging 115·5, 79·6, 98 and 50·2 for the four insecticides, respectively, and 46·2 for no treatment. The yields were highest for heptachlor, though γ BHC was not significantly inferior to it, intermediate for parathion, and almost as low for malathion as for no treatment.

Viel (G.) & Chancogne (M.). **Toxicité d'ingestion de quelques insecticides pour** *Ceratitis capitata* **Wied.**—*Phytiat.-Phytopharm.* **6** no. 4 pp. 217–221, 1 fig. Paris, 1957.

Although the insecticides applied against *Ceratitis capitata* (Wied.) act mainly by contact, small amounts of them may be ingested by the flies. The stomach action of four insecticides was therefore investigated. Adults kept without food for 24 hours were allowed to imbibe drops of 1 cu. mm. of the liquids from capillary tubes, and mortality was determined 24 hours later. The insecticides were diluted from proprietary emulsion concentrates except for DDT, an emulsified solution of which was prepared in the laboratory, and sugar was added to the water where possible. The lowest quantities of insecticide per fly that caused complete kill were 0·039–0·049 μg. malathion and 0·0245 μg. parathion or Dipterex [dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate]. DDT caused no mortality even at 0·98

μg. per fly. When leaves were sprayed with the three proprietary insecticides and drops of water were placed on the dried deposits four hours later and left for 45 minutes, after which they were carefully transferred to capillary tubes without touching the surface of the leaves, flies imbibing them as before showed variable mortality, but Dipterex and malathion usually gave high or complete kill in 24 hours.

Schvester (D.) & Bianchi (H.). *Cryptorrhynchus lapathi* **L. (Coleoptera Curculionidae), ravageur des osiers cultivés.**—*Ann. Epiphyt.* **8** no. 2 pp. 137–151, 3 figs., 12 refs. Paris, 1957.

Basket willows growing in the neighbourhood of Lyons have for several years been damaged by *Cryptorhynchus lapathi* (L.). Poplars, which are the main food-plant of this weevil, occur widely in the area and probably serve as centres of dispersion. The bionomics of *C. lapathi* were studied in a 25-acre osier bed containing mixed varieties and species of *Salix* that had been cut each year in autumn or early winter, so that the stools were almost at ground level. It was found that winter was passed by the young larvae in the stools [*cf. R.A.E.*, A **42** 110, etc.], in gall-like excrescences each containing 3–4, and that there were up to 20 larvae per stool. They developed slowly, but caused little damage, and pupated from mid-May onwards in cells at the base or in the stumps of rods cut in the previous year, the pupal stage lasting 2–3 weeks. Adult emergence was protracted; young adults were found from 14th May to 17th July in 1952 and from 19th June to 30th July in 1953. The adult population generally reached its peak between late July and mid-August, and it was then that most of the damage was done to the growing rods. Oviposition took place in the stools about three weeks after emergence, and the larvae hatched before winter.

The injury caused by the adults varied with the age of the rod. Feeding by recently emerged individuals occurred most often on the upper parts of young rods and resulted in withering of the terminal bud, with a subsequent development of side-shoots that rendered the rod useless for basket-making. When older, lignified rods were attacked, the feeding punctures became cicatrised and caused the rods to lose their pliability. Attacks by older weevils later in the season were of less importance, since the plant response was less severe, unless growth was still active, when feeding induced a reaction resembling canker. With populations of about 5 adults per sq. yd., such as occurred on susceptible varieties of willow, every rod was attacked and the crop greatly devalued. Since the eggs were laid in the stools, the annual cutting of the rods had no effect on infestation, and populations tended to increase. The adults have well developed wings but have not been seen to fly. Dispersal was not uniform, and this may be responsible for apparent anomalies in the choice of the willow species and varieties attacked, which are discussed in detail for the Lyons district and from the literature.

Tractor-mounted machine dusting of plots on 19th June, 16th July and 7th August with 6 per cent. BHC or 0·5 per cent. dieldrin at rates of 63–72 pounds per acre gave poor results, although laboratory spray tests had shown these materials to be toxic to the adults. The density and tufted habit of the foliage is thought to have prevented penetration by the dust.

Labeyrie (V.). **Observations sur le comportement de ponte de la mouche du céleri** (*Philophylla heraclei* **L.**).—*Ann. Epiphyt.* **8** no. 2 pp. 171–183, 5 figs., 20 refs. Paris, 1957.

In the cage experiments described, ovipositing females of *Acidia* (*Philophylla*) *heraclei* (L.) were attracted to the foliage of celery and selected the

shaded surface of the leaf for oviposition, to the almost total exclusion of the illuminated surface, although if both were shaded, the lower surface was preferred to the upper one; these two surfaces are referred to by the author as dorsal and ventral, respectively, because of their orientation to the plant axis in the early stages of growth. The percentages of eggs laid by the Trypetid in three series of experiments were 0–7·5 on the lighted dorsal surface, 0–2 on the lighted ventral surface, 71–81·5 on the shaded dorsal surface and 15–29 on the shaded ventral surface. These figures supported earlier observations that 79 per cent. of eggs were laid on the dorsal surfaces of leaves illuminated equally on both surfaces. The selection of the shaded surface was not related to humidity preferences. Females searching for oviposition sites explored both leaf surfaces initially, and did not appear to be able to distinguish surfaces already examined.

Vigne (J. P.), Chouteau (J.), Tabau (R. L.), Rancien (P.) & Karamanian (A.). **Contribution à l'étude du métabolisme d'un insecticide organophosphore: le diéthylthionophosphate de 2 isopropyl 4 méthyl 6 oxypyrimidine.**—*Ann. Epiphyt.* **8** no. 2 pp. 225–234, 5 graphs, 6 refs. Paris, 1957.

In an investigation of the metabolic fate of diazinon (O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate) in mammals, a female goat towards the end of the lactation period was given a single oral dose of 235·8 mg. of a sample of the chemical prepared from radioactive phosphorus; the animal weighed 36·5 kg. Excretion of radioactive material in the urine, faeces and milk, measured with a Geiger-Müller counter, was completed within four days, and the blood was free within two days; only very small amounts were found in the milk or blood. Only the urine showed any ability to inhibit horse-serum cholinesterase, and this was of a low order and persisted only for three days. The trial was repeated with similar results a month later, and it is concluded that diazinon, unlike the chlorinated-hydrocarbon insecticides, is rapidly metabolised in the animal body.

Martignoni (M. E.) & Auer (C.). **Bekämpfungsversuch gegen** *Eucosma griseana* **(Hübner) (Lepidoptera, Tortricidae) mit einem Granulosis-Virus.** [Attempted Control of *Enarmonia griseana* with a Granulosis Virus.]—*Mitt. schweiz. Anst. forstl. Versuchsw.* **33** fasc. 3 pp. 73–93, 4 pls., 4 graphs, 9 refs. Zurich, 1957. (With Summaries in French, Italian & English.)

An outbreak of *Enarmonia* (*Eucosma*) *griseana* (Hb.) on larch in the Engadine, in north-eastern Switzerland, reached its peak in 1954. In 1955, when the decline set in, field tests were made on the effectiveness against the larvae of a granulosis virus that had been isolated earlier in the outbreak [*R.A.E.*, A **44** 320]. An aqueous suspension was prepared in June from artificially infected larvae, mostly in the fifth instar, that had died of the disease and had been kept at 0–1°C. [32–33·8°F.] since June or July of the previous year. The suspension was filtered, and diluted with water before use to give an extract of 2·545 mg. larval material per ml. This was found to contain 580 million inclusion bodies per ml., which was 3·2 times as many as had been expected from examination of the dead larvae. Tests showed that the LD50 for fourth-instar larvae ingesting the extract was between $3{\cdot}64 \times 10^{-3}$ and $3{\cdot}64 \times 10^{-5}$ mg. larval material, and it was calculated that as the larvae consume 10–20 larch needles each during development from the third to the fifth instar, treatment of a tree with 5 litres of the diluted extract would result in more than this being ingested per larva.

The tests were carried out at three sites (Tarasp, Zuoz and Silvaplana), in which the populations of *E. griseana* were high and still increasing. Two trees were sprayed at each, and four selected as untreated controls. A portable mist-blower was used, mounted on a special cradle so that it could be hauled into the tops of trees 60–90 ft. high by a climber, who directed the mist into all parts of the crown, assisted by an observer on the ground. The applications were made in June, when most of the larvae were in the third or fourth instar, so as to allow a period of about 35 days before pupation, and most of them were made in the morning, at air temperatures of 9–18°C. [48·2–64·4°F.]. Light rain fell during the night after spraying at Zuoz, and heavy rain fell for 1½ days three days after spraying at Silvaplana. The results were determined from samples of twigs collected at intervals from each tree, and are given in detail for each site. In each case, there was a striking similarity in the mortality rates on treated and untreated trees, populations decreasing by about four-fifths in 18–21 days. On four of the six treated trees, mortality was less than that on the untreated ones. In laboratory tests in which healthy larvae were fed on twigs from Zuoz and Silvaplana that had been treated nine days previously, granulosis occurred in 54·3 and 35·1 per cent., respectively, as compared with 37·5 and 5·9 per cent. infection of larvae that fed on foliage from untreated trees. Histological examination of larvae collected during the third week of the tests showed that 6·5 per cent. from the treated trees were infected and 2·9 per cent. from the controls. The reasons for the disappointing results are not known, but more work is evidently needed on rates and methods of application, the timing of applications in relation to larval development, and the effect of ultraviolet radiation on virus suspensions at high altitudes.

Schindler (U.). **Forleulenbekämpfung 1956 im Südosten der Lüneburger Heide.** [Control of *Panolis flammea* in 1956 in the South-east of the Lüneburg Heath.]—*NachrBl. dtsch. PflSchDienst* **10** no. 2 pp. 17–21, 2 figs., 6 refs. Stuttgart, 1958.

Outbreaks of *Panolis flammea* (Schiff.) on pine are rare in north-western Germany, but the numbers of pupae in the soil rose above the critical level of about 1 per sq. yd. in the autumn of 1954 in the south-east of the Lüneburg Heath, in Lower Saxony, and the larvae completely defoliated one small area in 1955. The increase was probably due to unusually warm weather in April–June in 1953 and 1954 [*cf. R.A.E.*, A **23** 349]. There were over 50 pupae per sq. yd. in this area in the autumn of 1955 and more than about 2 per sq. yd. over a much wider area comprising about 7,800 acres. Examination of pupae from one locality in August–October showed that 35 per cent. were parasitised and 1 per cent. attacked by fungi and 3 per cent. by predators; 48 per cent. were females, and pupal weights were generally above the average [*cf.* **42** 56]. Counts in one part of the locality from autumn 1955 to March 1956 showed that there were 6 free Ichneumonid and 9 free Tachinid parasites per 100 pupae of *Panolis*. The parasites were not sufficiently numerous to be likely to prevent widespread damage by the larvae in 1956, and control operations were therefore carried out. The spring of 1956 was cold and wet. The adults were present from the end of April to the end of May, oviposition occurring shortly after emergence, and the larvae hatched from 17th May and in greater numbers after 25th May, when the weather became warmer. Treatment was begun on 4th June, when about two-thirds of the larvae had hatched. Thermal aerosols containing DDT were applied by a Tifa machine [**35** 259] from various oil solutions, mainly by night, and the rates of application were adjusted to give 0·54–0·72, 0·72–0·81 and 0·9–1·26 lb. DDT per acre, respectively, where the larvae were

predominantly in the second, third or fourth instar. The whole area had been treated by 25th June, and, despite frequent interruptions after the first few days due to bad weather, mortality was practically complete within two days over eight- to nine-tenths of it. Some larvae (mainly those in the fourth and fifth instars) survived in places in which the canopy was unusually dense or treatment had been carried out during bad weather, but an extra one or two applications at a rate of 1·8 lb. DDT per acre gave control in these. Very few pupae were found over most of the area in the autumn, but parasites, which emerged mainly from mid-June, were numerous, even in places treated 1–2 weeks previously. The locality in which the pupae had been counted before treatment was one of the last to be treated, and some of the larvae pupated in the autumn of 1956. Not more than 1 pupa was present per sq. yd., so that the critical level was hardly reached. Of the total, 51 per cent. were parasitised and 3 per cent. attacked by fungi and 1 per cent. by predators; only 38 per cent. were females, and pupal weights had fallen by one-sixth since the previous year. Counts of free Ichneumonids and Tachinids in the same place as before, which had received 2–3 applications, showed that these now numbered 2 and 64, respectively, per 100 pupae of *Panolis*.

Körting (A.). **Zum Schadauftreten des Hausbockkäfers.** [On Infestation by *Hylotrupes bajulus*.]—*NachrBl. dtsch. PflSchDienst* **10** no. 2 pp. 22–23, 1 fig., 3 refs. Stuttgart, 1958.

Investigations on damage by *Hylotrupes bajulus* (L.) to coniferous timbers in the roofs of buildings in localities to the north and north-east of Hanover in 1952–53 showed that of a random selection of 169 damaged roofs up to 80–90 years of age, 88 per cent. were less than 50 years old, about two-thirds 11–30 years old and few less than 11 years old. From 16 to 47 per cent. of those less and nearly all of those more than 50 years old contained damaged timbers in need of replacement. Investigations by the author near Hamburg, Lübeck and Bremen in 1949–52 gave similar results, and others carried out in Bremen in 1952–56 showed that 67 per cent. of 1,563 buildings were affected.

Drees (H.) & Schwitulla (H.). **Bekämpfung einer Epidemie von *Malacosoma neustria* L. durch die Tachine *Carcelia gnava* Meig.** [Control of an Epidemic of *M. neustria* by the Tachinid, *C. gnava*.]—*Z. PflKrankh.* **64** pt. 4 pp. 215–228, 4 figs., 19 refs. Stuttgart, 1957. (With a Summary in English.)

Malacosoma neustria (L.) was numerous in 1950 on fruit trees in a neglected plot near Cologne [*cf. R.A.E.*, A **47** 193, etc.], and investigations were carried out in 1950–53 on its biological control by means of the Tachinid, *Carcelia gnava* (Mg.), which was present in small numbers on the north-western edge. Adults of *Malacosoma* emerged mainly in June, and the egg-masses, which were first observed in July on the trunks and branches, overwintered. The larvae were first observed on 15th April in 1951 and 18th April in 1952, and, after feeding in webs in the tops of the trees, they generally descended to the lower parts of the crown, or even to the soil, and pupated between leaves. Pupation was first observed on 21st and 19th May in the two years, respectively, and the pupal stage lasted about 14 days. The first adults of *Carcelia* emerged on 22nd and 23rd April in 1951 and 1952, respectively, and oviposited in the newly hatched *Malacosoma* larvae. The parasite larva left its host as soon as this had constructed its cocoon

and pupated within or outside the webbing, more than one sometimes developing per host. The pupal stage lasted 2–3 weeks, and adults emerged in June–August, the first being observed on 7th and 4th June in 1951 and 1952, respectively. Parasitised *Malacosoma* larvae did not pupate. It was found that the adult parasites subsequently oviposited in larvae of *Arctia caja* (L.), which was also present on the trees [*cf.* **47** 193], and the larvae overwintered in these and left them in the following spring, some four weeks before the Arctiid larvae would normally have pupated.

In order to increase parasitism of *Malacosoma* by *Carcelia*, an increase was first effected in parasitism of *A. caja*. In 1950, *Malacosoma* webs containing puparia of the parasite were placed with females of *Arctia* in ten different positions on low vegetation, and 50 of the eggs laid by *Arctia* were left in each of the foci thus created, each of which had been provided with 15 parasite pupae. The nets used to isolate the foci were removed shortly before the pupation of the Tachinids in spring to allow movement of the *Arctia* larvae to the vegetation, and counts in the immediate vicinity of the foci after pupation showed totals of 316 *Arctia* larvae and 213 parasite pupae, whereas in the immediate vicinity of ten control positions, similarly isolated, the corresponding numbers were 208 and 11. At that time, the foci contained a total of 23 egg-masses of *Malacosoma*; 7,711 *Malacosoma* larvae hatched from these, 7,303 of them were attacked by *Carcelia*, and 8,423 parasites left them and pupated. In the control positions, which also contained 23 egg-masses, the corresponding figures were 7,633, 107 and 172. In the summer of 1952, 3,012 *Malacosoma* larvae hatched in the foci, of which 2,351 were parasitised, and 2,638 parasites emerged. Parasitism of *Arctia* was not investigated during that year, but there were 579 larvae in the foci in the autumn of 1953. The number had fallen to 523 by the time the parasites emerged from them and, in the spring, the parasite pupae totalled 216. The percentage parasitism had thus fallen in the foci, but many parasites had spread to other parts of the plot. Counts in 1952–53 in parts of the plot adjoining the foci showed that parasitism of *Malacosoma* was 11 per cent. and that of *Arctia* 21 per cent., and further counts over the whole plot showed that parasitism of *Malacosoma* reached 29 per cent. in 1952 and 85–88 per cent. in 1953.

Way (M. J.), Bardner (R.), van Baer (R.) & Aitkenhead (P.). **A Comparison of High and Low Volume Sprays for Control of the Bean Aphid, *Aphis fabae* Scop. on Field Beans.**—*Ann. appl. Biol.* **46** no. 3 pp. 399–410, 1 pl., 2 graphs, 13 refs. London, 1958.

The following is based largely on the authors' summary. Insecticides were applied in different amounts of water to control *Aphis fabae* Scop. attacking spring-sown field beans [*Vicia faba*] in southern England in 1954 and 1957 [*cf. R.A.E.*, A **43** 89]. The single application of each insecticide was timed to coincide with the end of aphid migration from the winter food-plant to the crop. A tractor-mounted row-crop hydraulic sprayer was used. In 1954, eight insecticides were compared in high-volume sprays (140 gal. water per acre). The most effective, with (in brackets) the weight in oz. of active ingredient applied per acre, were nicotine (22·4) and methyl-demeton [dimethyl 2-(ethylthio)ethyl phosphorothioate](11·2), each of which gave 96·4 per cent. control, and demeton [diethyl 2-(ethylthio)ethyl phosphorothioate] (5·6), which gave 95·7 per cent. control. DDT (44·8), endrin (11·2), parathion (4·5), γBHC (11·2) and malathion (22·4) all gave significant control, ranging from 81·5 to 93 per cent. In 1957, a further comparison was made of methyl-demeton, malathion, γBHC and two additional insecticides, for each of which a selected dose of active ingredient was applied in

60 gal. (medium volume) and in 10 gal. (low volume) of water per acre. The amount of insecticide retained on the plant following the low-volume application was not less than that from the medium-volume spray; the efficiency of the control obtained was not affected by spray volume except with malathion, which gave better results at the medium volume. Methyl-demeton (6 oz.) and two other systemic insecticides, compound 4741 [O,O-dimethyl S-(2-ethylsulphinyl-1-methyl)ethyl phosphorothioate] (referred to as dimethyl-S-(2-propylsulphinylethane)phosphorthiolate) (3 oz.) and fluoroacetamide (3 oz.), prevented aphid numbers from rising above a peak of eight per plant, as compared with 230 for a low-volume malathion spray (12 oz.), 2,400 for γBHC (6 oz.) and 3,550 on control plants sprayed with the wetting agent only. Yields of beans ranged from about 4 cwt. per acre for the control plots to about 27 cwt. per acre for plots sprayed once with a systemic insecticide. There was a curvilinear relation between bean yields and the logarithms of the numbers of *A. fabae* per stem.

Norris (J. D.). **Observations on the Control of Mite Infestations in stored Wheat by *Cheyletus* spp. (Acarina, Cheyletidae).**—*Ann. appl. Biol.* **46** no. 3 pp. 411–422, 1 graph, 11 refs. London, 1958.

Wheat stored in Britain almost always becomes infested by *Tyroglyphus farinae* (Deg.), for which *Acarus siro* L. is considered the correct name, and has to be fumigated, although control by *Cheyletus* sp. is sometimes so good that fumigation is unnecessary. Observations on the effectiveness of *Cheyletus* [*cf. R.A.E.*, A **31** 72; **35** 209] were made during inspections of imported wheat stored in bags or in bulk in north-eastern England in 1951–54, and the following is based on the author's summary of the results.

After 12–18 months, populations of *Cheyletus* had developed in 75 per cent. of the 77 parcels of wheat examined, and it became dominant over the other mites present in 67 per cent. of them. In the few instances in which the species concerned was determined, it proved to be *C. eruditus* (Schr.). Dominance was usually attained in late summer in bagged wheat. The control of *T. farinae* afforded compared favourably with that given by fumigation with methyl bromide and on occasion was superior. Both the development and dominance of *Cheyletus* were adversely affected by earlier fumigation, but there was some evidence that spraying the wheat with γBHC favoured the development of the predator and, in some circumstances, its dominance. Dominance by *Cheyletus* in bulk grain often occurred in the winter months, when the surface moisture content of the wheat was at its highest [*cf.* **35** 209]. The development of *C. eruditus* in a bulk grain store in which dense populations of *T. farinae* and *Glycyphagus destructor* (Schr.) were eliminated by it is described. The numbers of *C. eruditus* in wheat tended to increase more rapidly when the surface layers were disturbed than when the grain was undisturbed. Nevertheless, dominance over the other mites tended to occur first in undisturbed grain.

Dale (J. E.) & Coaker (T. H.). **Some Effects of Feeding by *Lygus vosseleri* Popp. (Heteroptera, Miridae) on the Stem Apex of the Cotton Plant.**—*Ann. appl. Biol.* **46** no. 3 pp. 423–429, 3 graphs, 14 refs. London, 1958.

The following is largely the authors' summary. The effects of damage to the apex of the main stem of the cotton plant caused by *Lygus vosseleri* Popp. were investigated in Uganda by means of a cell-counting technique. It was found that mechanical damage to the tip due either to feeding by

Lygus or to pricking with a needle caused an increase in cell division and maturation rates in the stem apex. In a discussion of the significance of these increases in relation to the possible effects of damage on plant height, it is suggested that the increased number of cells in the stem tips may cause the plant to grow taller [*cf. R.A.E.*, A **33** 88]. Feeding by *Lygus* can apparently damage only two of the young leaves folded round the shoot apex.

Jepson (W. F.) & Southwood (T. R. E.). **Population Studies on** *Oscinella frit* **L.**—*Ann. appl. Biol.* **46** no. 3 pp. 465–474, 2 graphs, 9 refs. London, 1958.

Observations in 1950–57 on the seasonal occurrence of *Oscinella frit* (L.) on late-sown oats in southern England showed that the emergence of adults of the overwintering generation begins about 7th–13th May, after one or two days with mean temperatures of 58–60°F., and reaches a peak about two weeks later. The flies die out rapidly during the first fortnight of June. Adults of the first or tiller generation begin emerging about 20th June, reach peak numbers about 2nd July, when the florets have been fertilised and are most susceptible to attack, and die out towards the end of the month. Emergence of the second or panicle generation reaches a peak at the beginning or middle of August unless temperatures fall below 55°F., when the peak may be delayed until early September; in mild weather, adults persisted until 1st November. Adults of this generation become widely dispersed over grassland. In 1950, adults of a further generation that developed from eggs laid on rye about 4th August emerged on 12th September. Temperature summations of over 500 day-degrees above 45°F. were recorded between successive peaks.

Populations of the different stages in each generation were estimated from field data in 1956–57 and are expressed as numbers per sq. yd. The numbers of overwintering larvae in short grass and rough uncut grass, respectively, averaged 78 and 10; many larvae were in poor condition and contained a yeast and a ciliate protozoan in the body cavity. The numbers of adults that emerged from these situations were provisionally estimated at about 6·8 and 1·5, and the adult population in the crop at 8·1. First-generation egg populations in the crop averaged some 420, and since the sexes are almost equal in numbers, the average number of eggs laid per female was thus apparently about 100. This figure appears rather high [*cf. R.A.E.*, A **23** 741], and the adult population was probably somewhat greater than the estimate showed. The combined population of larvae and pupae of the tiller generation was about 180, and there were about 302 dead or wilted shoots per sq. yd.; the difference between the latter figure, which represents a number rather below that of the larvae initially infesting the shoots, since a few shoots contain more than one, and the combined population figure can be ascribed to larval mortality. Parasitism among the larvae and pupae was estimated at 0·7 and slightly less than 1 per cent., respectively. The mean numbers of adults emerging from oats and from the adjoining short-grass headland between 26th June and 22nd July were 60 and 2·3, respectively, with a peak of 100 on the crops on 30th June. Eggs of the panicle generation were estimated at 8,480; there was usually one per floret, though up to seven were recorded, and they were laid chiefly on the outer and, to a less extent, the inner glumes. Larval populations estimated from grain dissections and grain damage averaged 3,062 (with less than 100 pupae and a few eggs) and 3,348, respectively, and the total pupal population after 2nd August was 3,772. Only 296 adults of this generation emerged (per sq. yd.) from the panicles and 4·5 from the short-grass headland.

Ibbotson (A.). **The Behaviour of Frit Fly in Northumberland.**—*Ann. appl. Biol.* **46** no. 3 pp. 474–479, 3 graphs, 5 refs. London, 1958.

Observations on the relation between weather and the daily activity of *Oscinella frit* (L.) were made in an exposed field of oats in Northumberland in 1957, when traps consisting of glass plates 8 in. square, painted yellow on one side and coated with adhesive on the other, were exposed from 1st June to 31st August on the ground in the crop or within circular areas of more or less bare soil, 4, 8 or 6 ft. in diameter, in it, or level with the tops of the plants. Few adults were trapped before 7 a.m. (some time after the sun rose) or after 5 p.m. (some time before it set) or on a dull day on which temperature was relatively low and humidity relatively high. Peak numbers were obtained usually between 11 a.m. and 3 p.m. (British summer time), and fewer flies were trapped per two-hourly period after the peak than before it. Males appeared to be more active than females. Intense flight activity between 10 and 11 a.m. was preceded by almost continuous feeding on vegetation and, particularly, on dead leaves and stems on the ground. At maximum temperatures in full sunlight activity mostly ceased, though in laboratory experiments it was almost incessant at high temperatures and low humidities. Similar numbers were caught in all the traps until the end of June, when the crop was 12–18 in. high, but significantly more were subsequently caught in the bare circular areas than elsewhere and in the larger than in the smaller circles. It is suggested that the rapid change in temperature at the periphery of a circle induces turning movements, so that all the flies within it are likely eventually to be trapped, whereas in the crop, where there are no temperature barriers, only those near the trap are caught. The number caught per unit area of traps was unaffected when larger or smaller plates were used, but with traps of different colours, the order of decreasing effectiveness was white, yellow, blue, clear glass, red and black, and the differences between white, blue, clear glass and red were significant. It is concluded that temperature is one of the main factors influencing activity, and that changes in it are as important as its actual value.

Kent (N. L.). **The Relation of Frit-fly Attack to the Milling Quality of Oats.**—*Ann. appl. Biol.* **46** no. 3 pp. 482–485, 3 refs. London, 1958.

Kernel content is one of the criteria adopted in assessing the milling quality of oats, and it is affected by the weight of abnormal grains in a sample. Common types of abnormal grains are those with decayed kernels, which discolour the milled product, blind grains [*cf. R.A.E.*, A **47** 52], with undeveloped kernels, and double grains, in which a smaller grain is partly enclosed within the main one and the average kernel content is low; these last give trouble during shelling. The average percentage content (by weight) of abnormal grains was 2·6 in Scottish samples in 1951 and 1952 and 13·8 in samples from Hertfordshire in 1950 and 1951. When abnormal grains are numerous, some of all types are generally found to be infested by *Oscinella frit* (L.), and segregation of the abnormal grains removes all the infested ones; if there are few abnormal grains, however, infestation is generally negligible and the abnormalities must be attributed to some other cause. Of the infested grains in samples of 12 varieties of winter and spring oats grown at ten places in England and Wales in 1955, 76, 19 and 5 per cent. were classified as decayed, blind and double, respectively. In the spring oats, 73 per cent. of the decayed, 26 per cent. of the blind and 30 per cent. of the double grains were infested, and the corresponding percentages for the winter oats were 49, 7 and 17. A highly significant

correlation was found between percentage weight of decayed kernels and percentage number of infested grains in the whole sample, and it was concluded that the latter could justifiably be calculated from the former. Over the period 1948–55, the content of decayed grains was consistently lower in Scotland and northern England than in south-eastern England. In 1955, the grain from certain varieties of spring oats was less infested than that from others grown at the same place, and winter varieties were usually less infested than spring ones. The percentage contents of blind and decayed grains in samples from Hertfordshire in 1950 and 1951 were significantly correlated, and infested grains with these abnormalities probably differ only in the stage of development at which infestation occurs. These samples also showed a highly significant partial correlation between the percentage contents of decayed and double grains, and it is concluded that in some areas and varieties infestation may result in the production of double grains. Infestations of 5–30 per cent. are calculated to reduce the kernel content of the oats by 0·7–4 per cent. when the kernels of abnormal grains are included in the milling products and by 2·7–17·2 when they are not. Since most British oatmeal mills are in Scotland and grind locally grown oats and since the few relatively large mills in southern England obtain over two-thirds of their oats from the north, the effect of infestation on milling quality is not of great practical importance.

Strickland (A. H.). **Frit-fly Attack and Yield of Oats.**—*Ann. appl. Biol.* **46** no. 3 pp. 486–493, 9 refs. London, 1958.

Work on loss in yield of spring-sown oats due to *Oscinella frit* (L.) in Britain was begun in 1953. Preliminary investigations showed that infestation by the first generation could usually be estimated satisfactorily from counts of damaged tillers made in mid-June. The visual estimation of damage is complicated by the presence of physiological deadhearts, which, with those resulting from infestation, fall after a few days, and by the delay of 7–10 days between attack and the appearance of symptoms, in consequence of which about a third of the infested tillers are undetected on any one day. The work showed, however, that some 3–12 per cent. of the tillers in commercial crops in England and Wales are visibly infested in June, and that the visible loss amounts to about 6 per cent. Dissection of samples taken just before harvest showed that grain damage is very low in northern England and heaviest in the east and south-east. Grain infestation was found to vary between about 4 and 20 per cent., and an average of about 8 per cent. of the grain was destroyed in any one year. Yield losses directly attributable to infestation were estimated in 1953–57 on plots in commercial fields in which oats were sown about 20th April (three weeks later than commercial practice) to ensure shoot infestation, and the effects of other pests were eliminated so far as possible; in some of the plots, infestation by *O. frit* was restricted by spraying with an insecticide at various stages of plant growth. Statistical analysis indicated that real differences between different parts of the country in the effect of attack on yield were not detected by the procedure and that the relation between pest density and yield did not change appreciably from year to year. A regression equation relating yield to mean percentage tiller attack and mean percentage grain attack at harvest was developed from the data, and, when this was used in conjunction with the visual assessments of tiller and grain damage and official data on acreage under oats and yield, it was found that the national loss of spring oats due to *O. frit* was twice as great in 1947, when the average drilling date was 16th April, as in 1949 and 1950, when most oats were sown before the end of March, that the annual loss from

grain damage in winter and early-sown spring oats averaged the equivalent of 167,000 acres, and that the combined loss from tiller and grain damage in late-sown spring oats (which represented about a third of the total acreage under oats) averaged the equivalent of 124,000 acres.

Bingham (J.) & Lupton (F. G. H.). **Breeding Spring Oats for Resistance to Frit-fly Attack.**—*Ann. appl. Biol.* **46** no. 3 pp. 493–497, 2 refs. London, 1958.

Investigations on the development of varieties of spring-sown oats resistant to *Oscinella frit* (L.) were made in eastern England in 1954–57. In a preliminary trial in 1954, in which sowings were made on 18th March and 13th April, three susceptible varieties (Star, Sun II and Victory) [*cf. R.A.E.*, A **37** 44] produced significantly fewer tillers per plant than two for which some resistance was claimed (von Lochow's Yellow and Eagle) and showed significantly higher numbers of infested tillers per plant. Oviposition preferences [*cf.* **46** 243] were investigated in these five varieties and a sixth (Summer) [*cf.* **37** 44] in 1955, 1956 and 1957 in plots sown on 19th, 23rd and 15th April, respectively. Significantly fewer eggs were laid each year on Summer and, to a less extent, von Lochow's Yellow and Eagle than on the susceptible varieties, and the differences between the numbers on Summer and one or both of the other two resistant varieties were significant in 1955 and 1956. When the yields from the experimental plants were compared with those from plants of the same varieties that had been sprayed against *O. frit* at the tillering and panicle stages, the increase was always least for Summer and greatest for Star, Victory and Sun II. In tests on panicle attack on plants sown on 4th and 15th April and 14th May and sprayed at the tiller stage in 1957, infestation was lowest in Star and heaviest in Eagle, Sun II and Victory in the first sowing and lowest in von Lochow's Yellow and heaviest in Eagle and Victory in the second; in the third sowing, Summer was considerably more heavily infested than the other varieties, among which infestation on von Lochow's Yellow was just significantly lower than that on Sun II and Victory. The intensity of panicle attack therefore probably depends largely on the stage of development of the plant at the time of oviposition.

Thomas (J. D.). **Control of Frit Fly by chemical Means.**—*Ann. appl. Biol.* **46** no. 3 pp. 497–501, 6 refs. London, 1958.

This review of work on the chemical control of *Oscinella frit* (L.) on cereals, largely in Britain, of which some of the results have already been noticed [*cf. R.A.E.*, A **40** 217; **41** 9; **45** 233], includes some hitherto unpublished information. Following the finding by T. J. Legowski in eastern England in 1952 that 10 per cent. BHC applied at 8 and 10 pints in 100 and 45 gal. water per acre, respectively, about a month after sowing halved damage to the shoots of oats and killed up to 45 per cent. of the larvae in about ten days, further trials with BHC and DDT were made in 1953. Sprays of 4–5 gal. 25 per cent. miscible DDT in 100 gal. water per acre or 1 gal. 10 per cent. BHC in 200 gal. water per acre, applied to late-sown oats two or four times at the tillering stage and again two or four times, respectively, when the panicles were emerging, caused substantial increases in yield and greatly reduced damage to the shoots and grains. DDT appeared superior to BHC, and eight applications of either to four, but the only difference that was significant was that between four and eight applications of BHC. The efficacy of DDT was confirmed in similar tests in 1954–56. Legowski & H. J. Gould obtained some evidence in 1957 that

the sprays reduced the number of eggs laid, and applications should therefore be made immediately before the peak of adult activity. Commercial oat crops cannot be sprayed while the panicles are emerging, owing to the mechanical damage involved, but injury by the first-generation larvae to the tillers alone is sufficiently great to justify control.

In attempts to discover an insecticide that would be effective when applied to oats only once, Legowski & Gould found in 1956 and 1957 that parathion gave substantial control and killed the larvae within the shoots. Sprays of parathion or dieldrin, both at 0·05 per cent., BHC at 0·1 per cent. and Rogor [O,O-dimethyl S-(methylcarbamoyl)methyl phosphorodithioate] at 0·5 per cent. applied to heavily infested oats gave highly significant reductions in percentage of damaged shoots in three weeks; parathion was the most effective, and BHC gave inconsistent results. Tests at three places afforded no evidence that dieldrin was superior to DDT in a schedule of four applications, and two applications of 2 per cent. toxaphene in 130 gal. water per acre or of 12 oz. 20 per cent. Metasystox [dimethyl 2-(ethylthio)-ethyl phosphorothioate] in 100 gal. per acre were less effective than the DDT spray.

In experiments with seed dressings, W. J. Bevan & G. Murdoch found in 1953 that 20 per cent. γBHC applied at 2–10 oz. per bushel of oat seed gave limited protection from very severe attacks for a month, and the highest rates reduced infestation by half. In view of findings that dieldrin was effective as a seed dressing [**45** 233], its value was compared with that of two applications of DDT spray in tests at 18 sites under conditions of relatively light infestation. The DDT spray significantly reduced infestation at the tillering stage at 15 sites and the seed dressing at three; at three sites, both treatments resulted in significantly increased yields. T. W. Nichol & R. Gair found that pure aldrin in brick dust applied by combine drill with the seed at 5⅓ lb. aldrin per acre significantly reduced damage to the tillers, but a 1·5 per cent. aldrin dust applied in the same way at 2½ lb. toxicant per acre was ineffective.

Casida (J. E.), Gatterdam (P. E.), Knaak (J. B.), Lance (R. D.) & Niedermeier (R. P.). **Bovine Metabolism of Organophosphate Insecticides. Subacute Feeding Studies with O,O-Dimethyl 1-Carbomethoxy-1-propen-2-yl Phosphate.**—*J. agric. Fd Chem.* **6** no. 9 pp. 658–662, 6 graphs, 16 refs. Easton, Pa., 1958.

The following is largely the authors' summary. Dairy cows that ingested subacute doses of Phosdrin (dimethyl 2-methoxycarbonyl-1-methylvinyl phosphate) daily in capsules for a period of 12 weeks showed marked blood-cholinesterase inhibition, but the insecticide was not detected in their milk or tissues. Tests with radioactive Phosdrin confirmed the lack of significant residues in milk or tissues and showed that the chemical was rapidly detoxified and excreted as dimethyl phosphoric acid. Calves that were fed on milk from the cows also showed reduced blood-cholinesterase activity. The compound was hydrolysed by cow, calf and human plasma to yield dimethyl phosphoric acid.

Ahmed (M. K.), Casida (J. E.) & Nichols (R. E.). **Bovine Metabolism of Organophosphorus Insecticides: Significance of Rumen Fluid with particular Reference to Parathion.**—*J. agric. Fd Chem.* **6** no. 10 pp. 740–746, 6 figs., 24 refs. Easton, Pa., 1958.

The following is based on the authors' summary. In laboratory tests, rumen fluid from a cow hydrolysed 16 organic-phosphorus insecticides to

varying degrees. Malathion and TEPP [tetraethyl pyrophosphate] were the most susceptible. Oxidation reactions were of much less importance than reduction reactions in metabolising the compounds and phosphorothioates were hydrolysed much more rapidly than phosphates. The rate of reduction of radioactive parathion in the rumen fluid of a cow that ingested it was similar to that *in vitro*. Parathion, paraoxon, and their amino derivatives (O,O-diethyl O-p-aminophenyl phosphorothioate and phosphate) were found circulating in the blood of the animal and were secreted in small amounts in the milk. Amino-parathion constituted a major excretory metabolite of parathion, together with diethyl phosphoric and phosphorothioic acids. The toxicological significance of these findings is discussed in relation to the toxicity of the various derivatives. The two amino compounds are much less toxic to house-flies [*Musca domestica* L.] and rats than parathion and paraoxon.

Miller (C. D. F.). **A new Species of** *Copidosoma* **closely related to** *C. nanellae* **Silvestri (Hymenoptera: Encyrtidae).**—*Pan-Pacif. Ent.* **34** no. 2 pp. 57–61, 6 figs., 2 refs. San Francisco, Cal., 1958.

Copidosoma deceptor, sp.n., is described from adults of both sexes reared from *Recurvaria* sp. on lodgepole pine (*Pinus contorta* var. *latifolia*) in Alberta and is recorded from various Lepidoptera in many parts of Canada and the United States. It was previously misidentified as *C. nanellae* Silv. [*cf. R.A.E.*, A **40** 378], which was described from Italy [**11** 517], and characters by which the latter differs from it are indicated.

Hall (J. C.) & Fleschner (C. A.). **A new Species of** *Stethorus* **Weise from Guatemala now being released in California (Coleoptera: Coccinellidae).**—*Pan-Pacif. Ent.* **34** no. 2 pp. 98–100, 5 figs. San Francisco, Cal., 1958.

A species of *Stethorus* here described as *S. guatemalensis*, sp. n., was found preying on *Oligonychus punicae* (Hirst) on avocado in Guatemala in March 1955 and was introduced into California. About 40,000 adults were liberated on *Citrus* in an attempt to establish the Coccinellid as a predator of Tetranychid mites there, and releases were also made in Texas and Florida. It was not known whether establishment resulted.

Breakey (E. P.) & Batchelor (G. S.). **Biology and Control of the Dryberry Mite,** *Phyllocoptes gracilis* **(Nal.).**—*Bull. Wash. agric. Exp. Sta.* no. 574, [2+] 17 pp., 6 figs. (4 col.), 8 refs. [Pullman, Wash.] 1957.

Loganberries grown in western Washington suffer from a condition known as dryberry disease, in which the young fruits dry up soon after the petals fall, and red and black raspberries are affected similarly. The injury was found to be due to *Phyllocoptes gracilis* (Nal.) [*cf. R.A.E.*, A **35** 130, etc.], and it resembles that caused to blackberries by *Aceria essigi* (Hassan) [*cf.* **21** 539].

P. gracilis was found to overwinter on canes of the previous year in colonies of 15–220 close to the axillary buds, into which the mites crawled as they opened in spring. Some evidence was obtained that they also overwinter on supporting posts. Eggs were laid in the expanding leaf buds, and during the growing season the mites were found on both leaves and fruits and within the opening flower buds. They were attacked by predacious mites of the genus *Seius*.

Tests on loganberry in 1946–50 showed that sprays of lime-sulphur or oil emulsion applied at dormant strengths in March, when the buds were beginning to expand, and again two months later at summer strengths, just before the flower buds opened, gave good control. Parathion, 1,1-di(p-chlorophenyl) ethanol (DMC) and a dinitro compound were about as effective. Several new acaricides were tested in 1955 in sprays applied on 24th–25th March, when the mites were still clustered near the buds, and again on 19th–20th May and 7th–8th July. Aramite (2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite) at 2 lb. 15 per cent. wettable powder per 100 U.S. gal. and chlorobenzilate (ethyl 4,4′-dichlorobenzilate) at 2 pints 25 per cent. emulsion concentrate per 100 gal. gave the best results, reducing the percentage of infested fruits to 5·34 and 6·53, respectively, as compared with 20·36 on untreated plants, but they were little more effective than lime-sulphur had been.

Rings (R. W.) & Brooks (R. F.). **Bionomics of the One-spot Stink Bug, *Euschistus variolarius* (Palisot de Beauvois), in Ohio.**—*Res. Circ. Ohio agric. Exp. Sta.* no. 50, 16 pp., 4 figs., 16 refs. Wooster, Ohio, 1958.

Euschistus variolarius (P. de B.) is one of the insects that cause the injury known as cat-facing of peaches in Ohio [*cf. R.A.E.*, A **46** 434, etc.], and its life-history was studied in an insectary in 1955–56 to supplement existing information [*cf.* **22** 324]. The Pentatomid had one complete and one partial generation in 1955, development lasting about 47 days in each, but only one generation in 1956, when development was completed in 57 days. The number was mainly influenced by temperature, as also were the duration of development and feeding, pairing and oviposition. The adults overwintered, and appeared to survive for about a year. Four Tachinid parasites were reared from the adults but they were of little value in control; parasitism was only 4·9 per cent. in 1955 and 1·3 per cent. in 1956. Of the parasites reared, 50 per cent. were *Gymnoclytia occidua* (Wlk.), 25 per cent. *Euthera tentatrix* Lw., 12·5 per cent. *Cylindromyia binotata* (Big.) and 12·5 per cent. *C. fumipennis* (Big.). The only predator observed was *Chrysopa* sp., which attacked the nymphs.

Walton (R. R.) & Kantack (B. H.). **Biology and Control of the Seed-corn Maggot on Spinach Foliage.**—*Bull. Okla. agric. Exp. Sta.* no. B-506, 20 pp., 5 refs. [Stillwater, Okla.] 1958.

Hylemyia cilicrura (Rond.) causes losses of spinach in Oklahoma, as in other parts of the United States [*cf. R.A.E.*, A **21** 611; **46** 434], by infesting the developing leaf clusters. Affected plants are not easily distinguished when the infestation is in its early stages, so that the larvae then persist in the harvested crop. Investigations on the bionomics and control of the Anthomyiid were carried out in 1948–57. It was found that the infestation resulted from oviposition on the foliage; larvae were never seen to migrate to the leaves from the soil, and larvae transferred from the soil to the leaves failed to become established. Oviposition extended over 20–30 days, most of the eggs being laid on compact plants 2–5 months old. The larvae hatched in an average of 1·2 days and became full-fed in an average of 25 days. The prepupal and pupal stages together lasted 11–18 days, depending on temperature. The adults were usually active from February to early June and from early September to early December, with peak periods in April and October. Infestations were heaviest in seasons of high rainfall, and low or absent in very dry ones. An abrupt transition from wet to dry weather

reduced populations; only 5 per cent. of plants bore eggs after a week of dry winds in March 1954, as compared with 54 per cent. in the preceding week.

During the last four years of the work, 15 insecticides were compared in various formulations for control of the larvae. Several contact insecticides, applied 4–6 times in high- or low-volume sprays, were of some value against early infestations on young plants, when the terminal leaf clusters were loose enough to be penetrated by the spray, but none of them reduced the population by more than 70 per cent. A single application of Phosdrin [dimethyl 2-methoxycarbonyl-1-methylvinyl phosphate] gave comparable control at 0·3 lb. per acre in a 0·12 per cent. spray and resulted in 89–100 per cent. reduction at 0·5 lb. per acre in the same spray or a 1 per cent. dust. In November 1957, granules containing 5 per cent. parathion, 10 per cent. malathion or 2·5 per cent. heptachlor were tested. Parathion at 1 lb. and malathion at 1·5 lb. per acre gave complete control, as compared with 93 per cent. reduction for heptachlor at 1·5 lb. and 90·2 per cent. for a 1 per cent. Phosdrin dust at 0·5 lb. toxicant per acre.

Turner (W. F.) & Pollard (H. N.). **Life Histories and Behavior of Five Insect Vectors of Phony Peach Disease.**—*Tech. Bull. U.S. Dep. Agric.* no. 1188, [1+] 28 pp., 3 figs., 9 refs. Washington, D.C., 1959.

The following is based largely on the authors' summary. At least six species of Cicadellids have been incriminated as vectors of the virus that causes phony peach disease in the south-eastern United States [*cf. R.A.E.*, A **45** 32, etc.]. The primary natural vectors are *Homalodisca coagulata* (Say) and *Oncometopia undata* (F.). *H. coagulata* was until recently misidentified as *H. triquetra* (F.) [*cf.* **40** 182], which is a Central and South American species and does not occur in the United States. *Graphocephala versuta* (Say) is next in importance. *Cuerna costalis* (F.) and *H. insolita* (Wlk.), which has recently increased in numbers [*cf.* **45** 32], are of doubtful importance, apparently inducing natural spread only rarely, and *Draeculacephala* sp. is not normally associated with peach. The first five are briefly described, and observations on their bionomics recorded.

H. coagulata, *O. undata*, *G. versuta* and *H. insolita* hibernate in woods, whereas *C. costalis* does so under matted grass in open fields and in orchards. The first three are general feeders, attacking many trees and shrubs, lists of which are given. *C. costalis* feeds principally on grasses and herbaceous plants, and *H. insolita* is restricted to a few grasses for food. Only *H. coagulata* and *O. undata* include peach among their preferred food-plants. All five species feed on stems, and this characteristic is important in the transmission of the phony peach virus, which is restricted to the xylem. Populations of all five species fluctuate markedly, largely as a result of weather, and low populations, particularly of *H. coagulata* and *O. undata*, are followed by a decline in the rate of spread of the disease on peach. *H. coagulata*, *O. undata*, *C. costalis* and *H. insolita* belong to the same tribe (Proconiini) and have two generations and a partial third in the year. They lay their eggs in clusters under the epidermis of a leaf or tender plant stem, most of those of the first two being laid in the leaves of herbaceous plants and those of the other two occurring in the blades or leaf sheaths of grasses. *G. versuta* has three complete generations and probably a partial fourth in the year and lays its eggs singly in the leaves of herbaceous plants.

Hymenopterous egg parasites were reared from all five species and Strepsiptera from adults of *C. costalis* and *O. undata*. The species concerned are noted, but no evidence was obtained that they have much effect on the size of the population.

Turner (W. F.) & Pollard (H. N.). **Insect Transmission of Phony Peach Disease.**—*Tech. Bull. U.S. Dep. Agric.* no. 1193, [1+] 27 pp., 1 map, 23 refs. Washington, D.C., 1959.

The following is based on the authors' summary. Investigations leading to the incrimination of Cicadellids as vectors of the virus of phony peach are reviewed [*cf. R.A.E.*, A **45** 32, etc.], and transmission studies are recorded from which it is concluded that *Homalodisca coagulata* (Say), *Oncometopia undata* (F.), *Cuerna costalis* (F.), *Graphocephala versuta* (Say), and *H. insolita* (Wlk.) are about equally effective as experimental vectors, the percentage of transmissions obtained ranging from 24 to 33. The virus of phony peach is a persistent virus, and has a latent period of at least eight days in the insect; the average period is considerably longer and is sometimes as much as 20 days. Insects that are infective remain so for long periods, probably for life, and one species (*C. costalis*) retained the virus overwinter for 144 days. The virus can be acquired by the nymphs, and on one occasion a tree was successfully infected by them. As few as two insects can infect a tree, but attempts to transmit with single insects failed. The importance of the various species in natural transmission is discussed [*cf.* preceding abstract]. The period during which natural spread takes place has not been precisely determined. Spread has occurred between 1st May and 31st August, and the evidence suggests that most of it takes place in June and July.

Blais (J. R.). **Effects of Defoliation by Spruce Budworm (*Choristoneura fumiferana* Clem.) on radial Growth at Breast Height of Balsam Fir (*Abies balsamea* (L.) Mill.) and White Spruce (*Picea glauca* (Moench) Voss.).**—*For. Chron.* **34** no. 1 pp. 39–47, 3 graphs, 10 refs. Toronto, 1958.

The following is virtually the author's summary. The relationship between defoliation by *Choristoneura fumiferana* (Clem.) and radial growth at breast height for balsam fir (*Abies balsamea*) and white spruce (*Picea glauca*) of merchantable size was studied in various stands in north-western Ontario. Defoliation was recorded yearly for these stands from the beginning of the infestation, and radial-growth measurements were obtained from increment cores. The first year of radial-growth suppression was calculated by comparing the growth of the affected species with that of jack pine (*Pinus banksiana*) and red pine (*P. resinosa*) by means of a growth-ratio technique. Apparent suppression in balsam fir and white spruce varied between stands and generally occurred at the earliest in the second year and at the latest in the fourth year of severe defoliation. A wide ring at the base of the tree coinciding with the first year of suppression, as reported by Craighead in a paper previously noticed [*R.A.E.*, A **13** 433], was non-existent.

Read (D. C.). **Note on a Flotation Apparatus for removing Insects from Soil.**—*Canad. J. Pl. Sci.* **38** no. 4 pp. 511–514, 3 figs., 2 refs. Ottawa, 1958.

The following is partly the author's summary. In studies on the life-histories and habits of root maggots [*Hylemyia*] and their predators in Prince Edward Island [*cf. R.A.E.*, A **47** 187], a method was required by which larvae and puparia could be separated uninjured from soil. The flotation methods described recently by Lafrance & Perron and by Read [**46** 22] for collecting puparia were unsuitable because of the stirring or pressure mechanisms involved, which often injured the insects. A new apparatus lacking

these mechanisms was developed and was found to provide a rapid and efficient method for separating many kinds of insects from sandy, loam or clay-loam soils. It consists essentially of a tank filled with water and a cylinder of aluminium screening, composed of two longitudinal halves, that is half-submerged in it horizontally and rotated by means of a crank. The soil sample is washed in the cylinder, which is simultaneously sprayed with water, until the soil and fine particles have settled at the bottom of the tank. The cylinder is opened and the material floating in it transferred on a piece of screening to a tray of water from which the insects can be removed by means of a strainer. The half-cylinder containing the rest of the sample is then dipped several times in clear water in the tray, when the remaining insects rise to the top of the débris and are removed with forceps.

Harcourt (D. G.) & Miles (J. R. W.). **Broadcast Treatments for Control of the Cabbage Maggot in Radish, and resultant Residues.**—*Canad. J. Pl. Sci.* **39** no. 1 pp. 43–47, 15 refs. Ottawa, 1959.

The following is almost entirely the authors' summary. In sandy loam soil in Ontario, granules of heptachlor and of aldrin, broadcast at 3 lb. toxicant per acre before sowing, gave 70–80 and 58–84 per cent. control, respectively, of a very severe infestation of *Hylemyia brassicae* (Bch.) on radish sown 0, 7, 15 and 21 days after treatment. Chlordane at 5 lb. in granules gave 4–48 per cent. control. The granules were applied to the surface of the soil with a hand fertiliser-spreader and raked into the top two inches. Insecticide residues on the radish roots at harvest were below the tolerances (0·25 part per million for aldrin, 0·3 p.p.m. for chlordane and 0·1 p.p.m. for heptachlor) recently established in Canada for this crop.

Andison (H.) & Cram (W. T.). **Chemical Control of the Narcissus Bulb Fly, *Lampetia equestris* (F.), in British Columbia.**—*Canad. J. Pl. Sci.* **39** no. 1 pp. 56–62, 17 refs. Ottawa, 1959.

The following is based almost entirely on the authors' summary. *Merodon* (*Lampetia*) *equestris* (F.) was controlled on southern Vancouver Island with insecticides applied by four methods at planting time to *Narcissus* bulbs grown in sandy loam soils of pH 5·9–6·5. Soaking the bulbs for 1½ hours in the mixture of hot water (temperature 110°F.) and formalin (40 per cent. formaldehyde) used for the control of nematodes, to which an emulsifiable concentrate of heptachlor was added at 2, 4 or 10 lb. toxicant per 1,000 gal., gave complete control throughout the two years of the test [*cf. R.A.E.*, A **46** 465]. Soaking the bulbs for ten minutes in cold water containing emulsifiable concentrates of dieldrin or heptachlor at 3 lb. toxicant per 100 gal., or of aldrin or chlordane at 5 lb., gave 93–98·5 per cent. control for three years [*cf.* **46** 464]; DDT at 5 lb. and γ BHC as lindane at 0·5 lb. were not effective. A dust of dieldrin at 3 lb. toxicant per acre, one of aldrin or heptachlor at 5 lb. and one of chlordane at 10 lb. applied to the bulbs in the open furrow gave 95–99 per cent. control for three years; γ BHC at 1 lb. did not give satisfactory control. A spray containing an emulsifiable concentrate of dieldrin at 1, aldrin or heptachlor at 2, or chlordane at 5 lb. toxicant per 100 gal. per acre, applied to the bulbs in the furrows, gave 91–96 per cent. control for the two years tested. The soil in the last test had the highest content of organic matter (13 per cent.); in the others, the mineral contents were moderately high (5–8 per cent.); γ BHC in the cold-water treatment was the only insecticide that adversely affected bulb growth.

Boyce (H. R.). **Chemical Control of the Lesser Peach Tree Borer,** *Synanthedon pictipes* **(G. & R.) (Lepidoptera: Aegeriidae), in Essex County, Ontario.**—*Canad. J. Pl. Sci.* **39** no. 1 pp. 75–79, 2 refs. Ottawa, 1959.

The following is based almost entirely on the author's summary. In experiments in Ontario in 1955–57, three applications to the lower parts of peach trees of an emulsion spray affording a total of 0·9–1·02 lb. endrin per acre, or of a spray of wettable parathion combined with emulsifiable malathion at respective total rates of 0·27–0·31 and 1·2–1·32 lb. per acre, gave reasonably consistent reductions both in the numbers of larvae of *Aegeria* (*Synanthedon*) *pictipes* G. & R. per tree and in the number of trees that became reinfested. Similar results were obtained with parathion at a total rate of 0·55–0·6 lb. per acre in 1956. In the only season in which it was used, dieldrin in an emulsion spray at a total of 1·03 lb. per acre was less effective than endrin or than parathion combined with malathion. In 1957, two applications of endrin gave as good results as three. Reduction in the number of larvae per tree in each year was good when the first of a series of three seasonal sprays of endrin or of parathion with malathion was applied when 12–29 per cent. of the moths had emerged or within 5–12 days of completion of treatments against the plum curculio [*Conotrachelus nenuphar* (Hbst.)].

Cram (W. T.) & Andison (H.). **Soil Insecticides for Control of Root Weevils in Strawberries in British Columbia.**—*Canad. J. Pl. Sci.* **39** no. 1 pp. 86–91, 6 refs. Ottawa, 1959.

The following is based on the authors' summary. A strawberry planting on a light, gravelly soil with a high mineral content (pH 5·8) in southern Vancouver Island was satisfactorily protected from *Otiorhynchus* (*Brachyrhinus*) *sulcatus* (F.) and *O.* (*B.*) *ovatus* (L.) throughout the 3½ years of its existence by a pre-planting soil application of a dust of 2·5 per cent. aldrin, 1·5 per cent. dieldrin or 5 per cent. chlordane at 5, 3 and 10 lb. toxicant per acre, respectively [*cf. R.A.E.*, A **44** 126], combined with an application of the appropriate dust to the transplant roots at 5 lb. per 10,000 plants. Three foliage applications, each at 30 lb. dust per acre, made in the first two years to control the adult weevils, were not necessary to give protection against the larvae when the soil and roots were treated. The numbers of larvae of *O. sulcatus* per plant and the yields in tons per acre from the treated plots in the third crop year averaged 0 and 2·8, in comparison with 11·6 and 1·1 from the untreated plots. In the latter, many of the plants were killed by larvae of *O. sulcatus*. Applications of the aldrin dust to the soil, roots and foliage, to the soil and roots, and to the soil alone gave an average yield per acre in the third year of 1·9 tons in comparison with 1·1 tons when applied to the roots alone and 0·02 ton from untreated plots. The treatments were not effective against larvae of *Sciopithes obscurus* Horn and species of *Nemocestes*, mainly *N. incomptus* (Horn).

LeRoux (E. J.). **Effects of various Levels of Calcium, Magnesium, and Sulphur in nutrient Solution on Fecundity of the Two-spotted Spider Mite,** *Tetranychus telarius* **(L.) (Acarina: Tetranychidae), reared on Cucumber.**—*Canad. J. Pl. Sci.* **39** no. 1 pp. 92–97, 8 refs. Ottawa, 1959.

The following is substantially the author's summary. The number of progeny of *Tetranychus telarius* (L.), reared in the laboratory on cucumber plants grown on a vermiculite base at three levels of calcium, magnesium

and sulphur, supplied as salts, decreased linearly as the dosage of calcium was increased. The average number that developed per female in 35 days on plants receiving 320 mg. calcium per litre of nutrient solution was 39 per cent. less than for plants receiving 160 mg. The results suggested a linear increase in the number of progeny when the level of sulphur was increased from 192 mg. per litre to 288 and 384 mg., and that the number of progeny was greater at 42 mg. magnesium per litre than at 28 or 56 mg. Concentrations of the three levels of calcium, magnesium and sulphur supplied were calculated and not confirmed by analysis. The concentrations of minor elements were not varied. The results indicate that, if calcium were used at appropriate levels in greenhouse fertilisers, populations of *T. telarius* on cucumber would be kept at lower densities.

Bondarenko (N. V.) & Kuan (Hai-yuan). **Peculiarities in the Origin of Diapause in different geographical Populations of** *Tetranychus telarius*. [*In Russian.*]—*Dokl. Akad. Nauk SSSR* **119** no. 6 pp. 1247–1250, 1 graph, 10 refs. Moscow, 1958.

A shortened photoperiod has been found mainly responsible for the production of overwintering females of *Tetranychus telarius* (L.) (*urticae* Koch) in the Leningrad district [*R.A.E.*, A **40** 127], but the importance of this factor has been denied in the cotton-growing districts in the south of the Soviet Union. Investigations were therefore carried out with mites from the Leningrad region, the Krasnodar area, Tiflis and Tashkent. They were reared on cotton in the greenhouse, and preliminary crossing experiments confirmed that they were all of one species. In tests in which the mites were kept at 20°C. [68°F.] from hatching, no overwintering females appeared when the light was continuous throughout the 24 hours, but high percentages developed when the photoperiod was reduced to 17 hours for the Leningrad mites [*cf. loc. cit.*], 12 hours for the Krasnodar mites, and 11 hours for the mites from Tiflis and Tashkent. The percentages of overwintering females that appeared in these last two populations did not much exceed 90, which is in agreement with the observation that some females reproduce in southern areas in warm winters. In further tests, mites of the four groups were kept under photoperiods of 16, 12, 10, and 10 hours, respectively, and the temperature was varied from 16 to 30 or 35°C. [60·8 to 86 or 95°F.]. The percentages of overwintering females produced decreased little or not at all between 16 and 20°C., but fell sharply to very low figures at 25°C. [77°F.], and the diapause seemed to occur most regularly in the Leningrad population. The high temperatures had no unfavourable effects on the mites.

The data obtained can be used to forecast the autumn fall in population. In Tashkent, for example, at an average temperature of 20°C., the population will include 44 per cent. overwintering females at the end of September or the beginning of October, and it will consist of none but these in the second and third ten days of November if the average temperature does not exceed 15°C. [59°F.]. It is calculated from the experiments that the critical photoperiod falls by 1 hour for each reduction of 3° in latitude, but the diapause occurs less regularly in the more southerly regions.

Rivnay (E.) & Yathom (S.). **Field Experiments in the Control of the Spiny Boll Worm.**—*Ktavim* (Engl. edn.) **8** no. 1–2 pp. 57–63, 2 graphs, 7 refs. Rehovot, 1958.

Field trials were carried out on the coastal plain of Israel in 1953–55 to compare the effectiveness of endrin [*cf. R.A.E.*, A **46** 420] with that of

toxaphene and Cryocide [cryolite] against *Earias insulana* (Boisd.) on cotton and to determine a suitable programme for its use. At Kubeiba in 1953, dilute emulsion sprays affording about 5·5–7 oz. endrin per acre, applied at intervals of ten days from about late June, resulted in a yield of 970 lb. cotton per acre, as compared with 538 lb. per acre from untreated plots. Endrin applied every 20 days resulted in a yield of 732 lb. per acre, and a wettable-powder spray affording about 4·4 lb. toxaphene per acre, applied at 10- and 20-day intervals, resulted in yields of only 132 and 396·5 lb. per acre, respectively. The poor yields from the plots sprayed with toxaphene, as compared with the controls, were due to the persistence of infestation on them throughout, whereas the pest migrated from the untreated areas after the severe initial destruction of squares and bolls, so that a late crop matured. At Acre in 1954, similar endrin sprays were applied to give nearly 10 and 20 oz. active ingredient per acre. Spraying began on 22nd July, and five applications were made at 14-day intervals or three at 21-day intervals. There were no significant differences in yield between the various treatments, probably because the plots were adjacent, but the average was about five times as high as that from the untreated plots. At Beit Dagan in 1955, the plots were separated by strips of groundnuts, which are not attacked by *E. insulana*. Endrin was applied at the same rates and intervals as in 1954, and 1 per cent. Cryocide at 14-day intervals. Spraying began on 11th July, and by early September the percentages of bolls infested averaged 12 for endrin applied at either rate at 14-day intervals, 30 for endrin at either rate at 21-day intervals, and 45 for Cryocide, as compared with 60 for no treatment; the differences between the two rates of application of endrin were not significant. The differences in yield between treated and untreated plots were less than in previous years, possibly owing to low pest populations. The averages in lb. per acre were 2,416 for no treatment, 2,363 for Cryocide, and 2,893 and 2,831 for endrin at the lower rate and 2,928 and 3,184 for endrin at the higher rate applied at 14- and 21-day intervals, respectively. Observations in 1956 indicated that *E. insulana* was becoming resistant to endrin [*cf.* **45** 332].

Avidov (Z.). **Phenology of the Olive Fruit Fly (*Dacus oleae* Gmel.) in the Coastal Plain of Israel.**—*Ktavim* (Engl. edn.) **8** no. 1–2 pp. 105–116, 7 graphs, 4 refs. Rehovot, 1958.

The following is based largely on the author's summary of this account of further observations on the seasonal occurrence of *Dacus oleae* (Gmel.) on olive in the coastal plain of Israel [*cf. R.A.E.*, A **45** 139]. Sampling of adult populations by means of trap-jars baited with a 5 per cent. solution of ammonium sulphate was carried out in 1952–56 at Hulda in a 112-acre olive grove consisting mainly of local varieties but including some European ones. The total catch per trap on the local varieties was about 40 per cent. higher than that on the European ones, although population trends were parallel for both groups. About half the total annual catch was taken during October–November, and the lowest catches were recorded during the first five months of the year [*cf.* **39** 62]. The ratios of the total catch per trap in a year of heavy infestation to those in one of light infestation were 14:1 and 18:1 for European and local olives, respectively. Although annual differences in catch were observed, the varietal differences were similar from year to year. The number of flies trapped in June was directly related to the number present in the previous November. A mean temperature of more than 26°C. [78·8°F.] in July resulted in fewer flies being caught later in the summer, whereas catches were high when the July temperature had

been lower. The reproductive capacity of the summer generations, and hence the degree of fruit infestation in August and September, is determined by the number of flies present in June and July and the temperature in July. The local olives were attacked at least a month later than the European ones; July and August are therefore the critical months for them. When the monthly mean temperature in autumn was 23–24°C. [73·4–75·2°F.], populations increased steadily and caused much injury to fruits left on the trees after October, but oviposition ceased in late November or early December. Females comprised about one-third of the total catch, although laboratory breeding had shown that the sex ratio was 1:1. Gravid females comprised 19 and 16 per cent. of the total catch on the European and local olives, respectively. During June, females were attracted from the local olives to the European ones, on which fruits suitable for oviposition were available. Most eggs (averaging 8·9–9·9 per female, with a maximum of 48) were found in dissected females during September–November.

Avidov (Z.), Moore (I.) & Harpaz (I.). **Dieldrin versus Diazinon in the Control of the Olive Fruit Fly (*Dacus oleae* Gmel.) in Israel.**—*Ktavim* (Engl. edn.) **8** no. 1–2 pp. 117–126, 6 refs. Rehovot, 1958.

In continuation of field trials on the control of *Dacus oleae* (Gmel.) on olive on the coastal plain of Israel [*R.A.E.*, A **44** 114, etc.], dieldrin and diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] were compared in 1955 on two varieties.

At Na'an, on early olives, gravid females first appeared during the last week of May, when they comprised 40 per cent. of the females captured in trap-jars containing 5 per cent. ammonium sulphate, and infestation had already begun, but the trees could not be sprayed immediately. The treatments tested comprised one application of 0·2 per cent. dieldrin in an emulsion or wettable-powder spray or 0·2 per cent. wettable dieldrin with 0·03 per cent. wettable diazinon, made on 3rd June, one of 0·2 per cent. wettable dieldrin on 3rd June followed by another on 6th July, when first-generation adults emerged in the laboratory, and one of 0·06 per cent. diazinon in an emulsion spray directed against eggs and larvae and made on 15th June, when the oil content of the olives had not reached the recommended level of 3 per cent., but third-instar larvae, which are less susceptible to the insecticide, were already present. Survival of eggs and young larvae in the diazinon-sprayed fruits was in general high after 26th June, and the only treatments to give significant reductions in infestation at harvest on 8th August were those in which dieldrin was applied alone, which reduced the percentage infestation from 22·7 for no treatment to 9·4–14·6; two applications were no better than one. Residues of dieldrin on the harvested olives were 0·1 part per million for the wettable powder and 0·3 p.p.m. for the emulsion.

At Hulda, on late olives, the oil content of the fruits averaged 6 per cent. by 29th June and infestation was unusually early, so that the use of dieldrin as a preventive measure was precluded. Diazinon was therefore applied at 0·04–0·1 per cent. on 8th July. Survival of eggs and young larvae was high after three weeks, but had fallen again by picking time (5th September), when the percentage infestation averaged 7·3, 7, 1·6 and 1·3 for diazinon at 0·04, 0·06, 0·08 and 0·1 per cent., respectively, as compared with 9·5 on untreated trees, only the last two concentrations giving significant control. It is noted that the fruits in this test were picked before the main autumn attack had begun.

Bridges (R. G.). **Fate of labelled Insecticide Residues in Food Products. VI. Retention of γ-Benzene Hexachloride by Wheat and Cheese.**—*J. Sci. Fd Agric.* **9** no. 7 pp. 431–439, 4 figs., 25 refs. London, 1958. **VII. The Fate of γ-Benzene Hexachloride Residues in Flour during Baking.**—*T. c.* pp. 439–448, 3 figs., 20 refs.

As γ BHC is being increasingly used for the control of insects and mites that infest stored foodstuffs and is persistent enough to leave a residue, especially in fatty materials, the fate of the residues in certain products was investigated. The results are given in these two parts of a series [*cf. R.A.E.*, A **44** 401], and the following paragraphs are virtually the author's summaries of them.

γ BHC labelled with ^{14}C was used to study the rate of loss of the insecticide from whole wheat and its distribution between the flour and bran fractions after milling. Loss from exposed wheat was rapid, but when it was stored in closed containers no loss was detected. After milling the wheat, 40–50 per cent. of the initial residue was still present in the " fine " flour fraction, while the residue in the bran was increased between two- and four-fold. Loss of the insecticide from Cheddar and Stilton cheeses was slow, about 40 per cent. of the weight applied remaining after 44 weeks. Penetration of the insecticide into both types of cheese was slow, although appreciably more rapid in the Stilton cheese. Repeated applications caused a build-up of the insecticide in the outer few millimetres of the cheeses, but had little effect on the amount penetrating more deeply. The toxicological significance of such residues is discussed.

^{14}C-labelled γ BHC was used to study the effect of heating at baking temperatures on the insecticide when present in wheat starch, gluten and milled wheat. The amounts of ^{14}C-activity retained by the starch and gluten after heating for ½ hour at 180°C. [356°F.] depend on the initial moisture content of the materials. With milled wheat at moisture contents between 0·4 and 17·3 per cent., little difference in the amount of ^{14}C-activity retained was observed, but when mixed into a dough with water prior to heating, a greater proportion of the initial ^{14}C-activity was retained. The residue remaining after heating was " locked up " in the desiccated starch granules and could not be extracted with acetone until the heated material was treated with water. The residue in the heated starch consisted mainly of unchanged γ BHC, but that in the flour was shown to be mainly a mixture of tri-, di- and monochlorobenzenes. The toxicological significance of these breakdown products in bread is discussed.

Salmond (K. F.). **Investigations into Grain Storage Problems in Nyasaland Protectorate with special Reference to Maize** (*Zea mays* **L.**).—*Colon. Res. Publ.* no. 21, [2+] 49 pp., 4 pls., 16 figs., 37 refs. London, H.M.S.O., 1957. Price 4*s.* 6*d.*

The insects and other arthropods associated with maize stored in Nyasaland and their importance and control were investigated in 1951–55. The methods of storage in use, both African and European, are described, and notes are given on the occurrence and status of the species found, of which the most important were *Calandra oryzae* (L.) and *Sitotroga cerealella* (Ol.). Both attack the growing crop and subsequently increase on the maize in store, but *S. cerealella* is chiefly found in maize stored on the cobs and was not collected at depths greater than one foot in bulk shelled maize. *C. oryzae* breeds continuously in stored maize and completes a generation in 36–40 days. The development of varieties of maize with hard grains and ears well covered by the sheaths is recommended to reduce infestation in the field.

The only other primary pest found was *Ephestia cautella* (Wlk.). Numerous secondary pests were present, including *Tribolium castaneum* (Hbst.), *T. confusum* Duv., *Gnathocerus maxillosus* (F.), which appears previously to have been confused with the first two, *Cryptolestes* (*Laemophloeus*) *minutus* (Ol.), *Rhizopertha dominica* (F.), *Oryzaephilus* (*Silvanus*) *surinamensis* (L.), *O.* (*S.*) *mercator* (Fauv.), and *Plodia interpunctella* (Hb.).

Surveys showed that an average of 65 per cent. of the cobs stored in large basket-work containers were injured, with an average of 7·5 per cent. of the grains damaged per cob. The shelled maize brought to African markets showed an average of 4 per cent. damaged grains. Shelled maize stored in bags at the central depots was infested to varying degrees, depending on the insecticidal treatment applied, and in an experiment in which bags of untreated maize were stacked under a tarpaulin cover, damage, estimated as weight loss, increased from 4 to over 45 per cent. in 15 months but by very little more in the following three. Observations on the moisture content of maize in bags at the edge of a 1,000-ton stack indicated a possible increase or decrease of 4 per cent. during a normal season. During investigations of the changes in moisture content, relative humidity and temperature in maize stored under various typical conditions, insect infestation in artificially dried maize that was stored in an open-topped concrete silo bin for 16 weeks, mostly during the wet season of 1952, was reduced but not eliminated by the drying temperature employed (175°F.). A maximum initial moisture content of not more than 13·5 per cent. is recommended for maize that is to be stored.

In tests to determine the value of underground storage [*cf. R.A.E.*, A **44** 136] under local conditions, a pit capable of containing 130 short tons of maize was excavated to a depth of 8 ft. and provided with walls 6 in. thick made of concrete containing a waterproofing compound and painted with two coats of bitumastic paint and a top coat of white oil paint. This was filled with shelled maize, which formed a mound above ground level and was covered with two layers of overlapping strips of ruberoid (bitumenised two-ply felt) with wire netting between them. The lower layer was sealed to the rim of the pit and the ends of both layers projected beyond the pit and were buried in trenches dug round it; soil was heaped over them to form a slope continuous with the sides of the mound of grain, and the exposed ruberoid was painted with white oil paint. The maize had a mean moisture content of about 10 per cent. and was infested by *C. oryzae* at a density of six adults per 500 g. It remained undisturbed from November 1950 until March 1952, when the pit was opened. The grain was then free from infestation and showed little damage by insects, but a layer 1 ft. deep at the bottom was wet and had fermented. The pit was accordingly further waterproofed by bitumenising the lower half, tanking the floor space, and repainting the upper half twice with bitumastic paint, after which it was filled with maize and covered as before, except that the cover was sealed to the rim and did not project beyond it and the exposed ruberoid was painted with bitumastic paint and covered, two days later, with a 12-in. layer of firmly packed soil. The initial moisture content of the maize was about 10 per cent., and infestation (by *C. oryzae*) amounted to 14·6 adults per 500 g. The maize was left from December 1952 to May 1955, and was then free from infestation, with only 0·3 per cent. damaged by water. This method of storage is considered especially suitable for long-term famine reserves.

At the central storage depots, sprays of wettable DDT applied to the exposed surfaces of bags of maize in stacks during 1951–52 and a dust of 6 per cent. γ BHC applied to the outsides of the bags as the stacks were built, at 2 g. per sq. ft. of exposed surface, during 1951–53 gave only limited protection, and insecticide dusts mixed with the shelled maize tended to sink to the bottom of the bags during subsequent handling. In 1953–54,

nearly 32,000 short tons of bagged maize in stacks was fumigated for 24–36 hours under polyvinyl sheeting with methyl bromide [*cf.* **44** 341] at 2 lb. per 1,000 cu. ft. space where the floors were sound and 3 lb. where they were faulty and for outside stacks on temporary dunnage, and 40,000 tons were fumigated in the same way during 1954–55. Excellent initial control was obtained, except where the sheets were blown open by high winds, but the stacks had become reinfested with *Tribolium* spp. 5–6 months later. In experimental fumigation of shelled maize stored in silos of iron or of brick and concrete, methyl bromide was ineffective, presumably because of leaky construction, and a proprietary fumigant containing carbon tetrachloride and ethylene dichloride (3:1), used at 2 gal. per 12 tons of maize, with an exposure of 48 hours, gave variable results but was ineffective when the space above the maize was less than 12–18 in. Maize stacks at the central depots are sprayed with DDT immediately after fumigation and also dusted with a mixture of BHC and DDT, but, owing to uneven application of the dust to the bags by the African labourers, considerable peripheral infestations by *E. cautella* build up, and reinfestation by *T. castaneum* and *T. confusum* occurs; *P. interpunctella* was found on fumigated maize at one centre. Routine spraying of the stacks with γ BHC as lindane at 20 mg. per sq. ft. of surface area or with a mixture of 8 oz. 50 per cent. wettable DDT and 6 oz. 25 per cent. wettable γ BHC per gal. applied at 1 gal. per 1,000 sq. ft. of surface at monthly intervals under European supervision is recommended.

Other recommendations for the reduction or prevention of infestation include the rapid transference of maize from the markets to the central storage depots followed by fumigation with methyl bromide and refumigation of maize for export after six months, and the encouragement of African farmers to store only sound cobs, to sprinkle wood-ash among them to hinder the movements of insects, and to maintain the storage containers under hygienic conditions. *Trogoderma granarium* Everts, a few examples of which were found during the survey, is considered to be of potential importance [*cf.* **44** 341; **45** 370], and produce in which it is detected should immediately be fumigated with methyl bromide.

Very brief notes on insect infestation in stored rice [*cf.* **44** 397], wheat, sorghum and millet (*Eleusine coracana* and *Pennisetum typhoides*) are given in an appendix.

Burges (H. D.). **Studies on the Dermestid Beetle *Trogoderma granarium* Everts. I. Identification and Duration of the developmental Stages.** —*Ent. mon. Mag.* **93** pp. 105–110, 1 pl., 1 fig., 8 refs. London, 1957.

Larvae of *Trogoderma granarium* Everts developing in stored products frequently migrate to crevices in the fabric of the storehouse, from which they later emerge and infest new produce. Laboratory studies were made of the duration of development and the morphology of the larval instars [*cf. R.A.E.*, A **44** 85–86] in connection with investigations of this behaviour, and the following is based almost entirely on the author's summary of the results. At 30°C. [86°F.] and 70 per cent. relative humidity, the egg stage lasted a mean of 6½ days, the larval instars 5–7 days each, and the pupal stage 4½ days. Most males passed through five and most females through six instars. Larval and pupal development together occupied a mean of 39·2 days for males and 44·5 days for females when the food was wheatfeed. Mortality was low and occurred chiefly in the first larval instar. Adult females were considerably heavier than males, but the young larvae of different sex did not differ in weight. Daily disturbance and a daily period at room temperature (15–20°C. [59–68°F.]) for observation slightly delayed larval development. Development was rather more rapid in larvae reared

on wheatfeed alone than in those reared on a mixture of wheat and wheatfeed (20:1 by weight). Only the first larval instar could be distinguished with certainty, the later instars becoming progressively more difficult to separate. Some variation was found in the arrangement of the barbed hairs on larvae from stocks originating from Britain and Nigeria, and evidence is cited from the literature of further variation in stocks from Germany and India.

Böhm (H.). **Auftreten der Spinnmilbe** *Brevipalpus oudemansi* **Geijskes in Österreich.** [The Occurrence of *B. geisenheyneri* in Austria.]—*Pflanzenschutzberichte* **18** pt. 3–5 pp. 39–40, 2 refs. Vienna, 1957. (With a Summary in English.)

Brevipalpus geisenheyneri (Rübs.) (*oudemansi* (Geijskes)) [*cf. R.A.E.*, A **43** 21] was observed in the late summer of 1956 on apple near Vienna and in several fruit-growing districts of Lower Austria. It was also reported to occur near the Neusiedlersee.

Lyngnes (R.). **Studier over** *Hylecoetus dermestoides* **L. (Col., Lymexylidae) under et angrep på bjørkestokker på Sunnmøre 1954–1955.** [Studies on *H. dermestoides* attacking Birch Logs at Sunnmøre in 1954–55.]—*Norsk ent. Tidsskr.* **10** pt. 4–5 pp. 221–235, 8 figs., 9 refs. Oslo, 1958. (With a Summary in English.)

The finding of birch logs infested by *Hylecoetus dermestoides* (L.) at Sunnmøre, Norway, in 1954–55, permitted observations on the behaviour of this Lymexylid. The processes of pairing and oviposition and the larvae of various ages are described. The females laid up to 108 eggs each in the laboratory, oviposition occurring on the bark surface in late May as soon as the temperature exceeded 10°C. [50°F.]. Females were not attracted to logs less than three months old, and of the logs available they preferred the oldest, which had been cut some 15 months before. The larvae possess a caudal appendage that is used to push wood particles backwards out of the gallery, as a protective device, and possibly as a carrier for spores of the fungi on which they feed [*cf. R.A.E.*, A **9** 196]. In addition to *Endomyces hylecoeti*, the fungus on which the larvae usually feed, other fungi, including species of *Isaria*, *Aspergillus* and *Verticillium*, were found in the galleries, and spores of *Verticillium* were observed adhering to the maxillary palps of adult males. The relative importance of the two sexes in the dissemination of fungi is discussed.

Papers noticed by Title only.

Empson (D. W.). **Frit Fly** [*Oscinella frit* (L.)] **and the Oat Panicle.**—*Ann. appl. Biol.* **46** no. 3 pp. 479–482. London, 1958. [*Cf. R.A.E.*, A **47** 52.]

Adams (P. A.). **Insects of Micronesia. Vol. 8 no. 2. Neuroptera: Myrmeleontidae and Chrysopidae.**—pp. [5+] 13–33, 11 figs., 1 map. Honolulu, Bishop Mus., 1959. Aczél (M. L.). **Vol. 14 no. 3. Diptera: Neriidae and Micropezidae.**—pp. [3+] 47–90, 12 figs., 1 map. 1959. [*Cf. R.A.E.*, A **43** 345; **47** 76.]

INDEX OF AUTHORS

NOTICES

Secretaries of Societies and Editors of Journals willing to exchange their publications with those of the Institute are requested to communicate with the Director. Authors of papers on economic entomology, whether published in entomological journals or not, are invited to send reprints to the Director for notice in the *Review*.

The Executive Council of the Commonwealth Agricultural Bureaux is a signatory to the Fair Copying Declaration, details of which can be obtained from the Royal Society, Burlington House, London, W.1.

The Annual Subscription, *in advance*, to a volume of the *Review* Series A (Agricultural) is 60s. post free; Series B (Medical and Veterinary), 30s. post free. Prices of Back Volumes on application.

Orders and Subscriptions should be sent to the Director, Commonwealth Institute of Entomology, 56, Queen's Gate, London, S.W.7, or through a bookseller.

CONTENTS.

[*Continued on p. iv of cover*

CONTENTS—*cont.*

Printed in Great Britain by The Eastern Press, Ltd., London and Reading